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FIRST AERO WEEKLY IN THE WORLD

NOV 25 1936

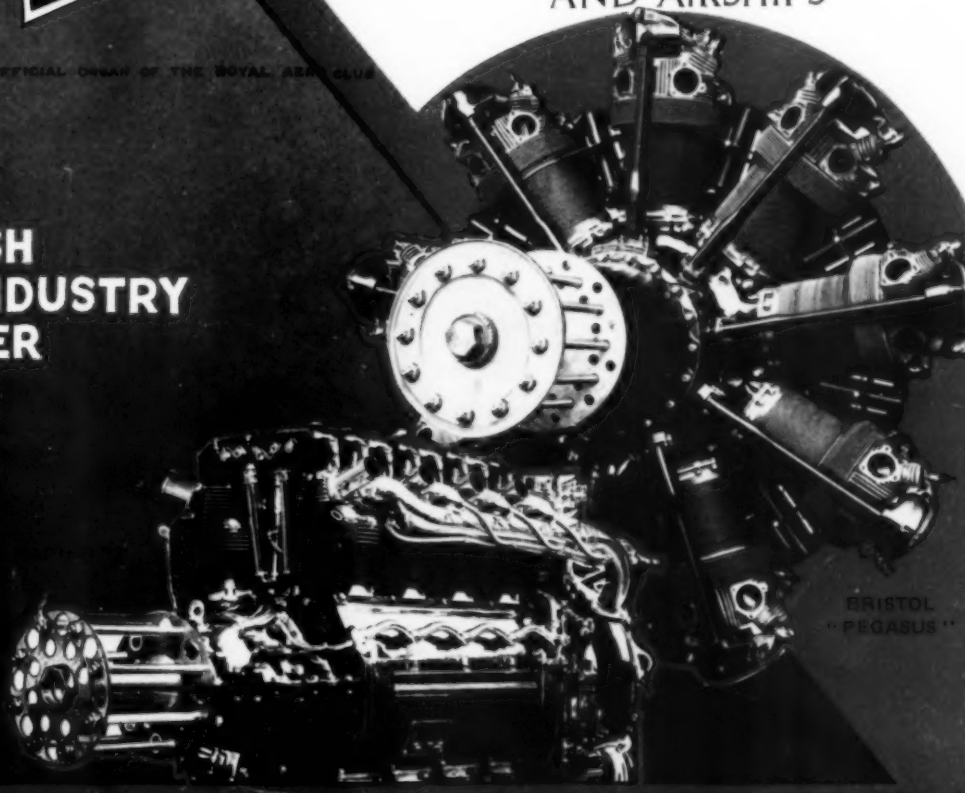
FLIGHT

6d.

The AIRCRAFT ENGINEER AND AIRSHIPS

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

BRITISH AIRCRAFT INDUSTRY NUMBER



BRISTOL "PEGASUS"

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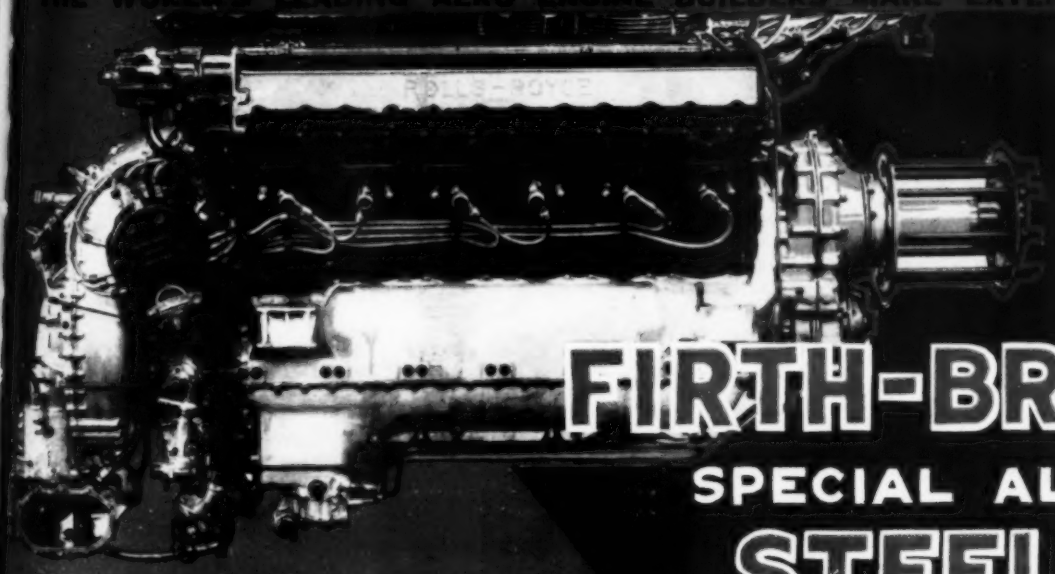

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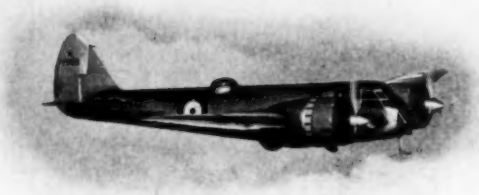

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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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British Aviation

FOR a considerable period of years it has been *Flight's* custom to review annually, in a special issue, the British Aircraft Industry. The autumn is in many ways the most suitable time of the year for such a review, and this year the Paris Aero Show affords one more reason for publishing the feature this week. The Paris Show will be opened officially by the French President to-morrow morning, and will remain open until Sunday, November 29. It would obviously be impossible, even were it deemed desirable, for more than a very small percentage of the British firms engaged in the design and manufacture of aircraft, aero engines, materials, and equipment, to exhibit at Paris. For some reason rather difficult to trace, the international aero exhibitions held in Paris have, in the course of the years, assumed an importance far beyond their intrinsic value, and representatives from all over Europe visit these shows in the Grand Palais des Champs Elysées with great regularity. Thus, a special issue of *Flight* devoted to the products of the British Aircraft Industry, widely distributed throughout Paris during the period of the Paris Show, supplements the exhibits to be found within the walls of the Grand Palais, and forms a very handy reference volume, not only for those who visit Paris, but also, and to an even greater extent, for those who are not able to go there. The issue is, in fact, the equivalent of a British aero show held concurrently with the French one, and has the advantage that its utility is not confined to one city or country, but is, in effect, of truly international appeal, in that it circulates not only in Europe but throughout the world.

As a result of ready co-operation on the part of the 300-odd firms which combine to form the British Aircraft Industry, *Flight* is able to publish this week a very full and comprehensive survey of the entire field of British aeronautical activity, ranging from complete aircraft and aero engines down through materials, equipment and instruments to the smallest component and accessory which goes to make the complete aircraft.

The types of aeroplane reviewed cover the whole range from the smallest single-seater light aeroplane to the heaviest multi-engined bomber, and the aero engines range in power from the 20 h.p. two-cylinder type to the 1,000 h.p. or more multi-cylinder units used in the high-powered military machines.

Performances of aircraft and engines have improved greatly during the last year or so, partly due to the work of the metallurgist in providing the designer with better materials, and partly to a greater familiarity with these materials, which has enabled the designer to make full use of their improved qualities. The result is reflected in greater strength for smaller weight, in the case of the aircraft, and greater power for the same, or even lower, weight in the case of the engines.

Clean Design

Aerodynamically, also, a vast improvement in design is noticeable, and the gibe of a well-known American humorist to the effect that British aircraft carry their own "built-in headwinds" no longer applies. In aerodynamic no less than in structural efficiency, British aircraft can now legitimately be claimed to hold their own in a comparison with the products of other countries.

With our aero engines we have every reason to be satisfied. For sheer excellence of workmanship they are unbeaten, and their reliability is now such that a sudden forced landing is something of a rarity. The accessories and equipment found in modern British aircraft are of a very high order of excellence, and their range and variety are obvious from an inspection of pages 516-535 of this issue of *Flight*.

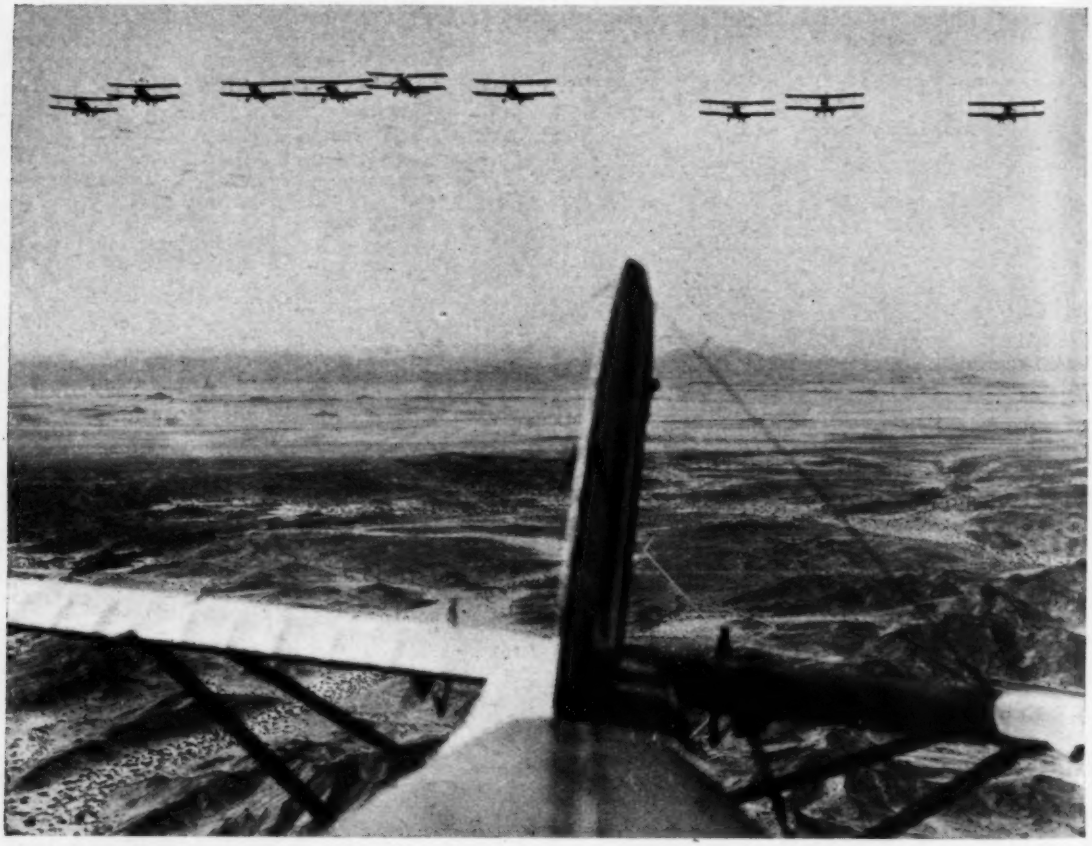
Finally, it may be pointed out that, good as are the military types of aircraft described, there are even better types to come in the very near future, but of these nothing may be said at the moment. The same applies to the high-powered engines, several of which are about to be re-rated in the near future, when they will show even better power-weight ratios than those which may be quoted at present. Moreover, several quite new models, as distinct from existing types to be rated at higher powers, are coming along in the near future.

Protecting the Midlands

"COVENTRY is not so very vulnerable," replied Sir Philip Sasoon, when questioned in the House of Commons as to what would happen to the shadow industry if an air raid wiped out the factories in the motor city. It is very comforting to learn this fact from the Under-Secretary for Air; and it is certainly the case that the farther a place is from the south and south-east coasts the more chance there would be of the air defence organisation getting timely warning of a raid and of taking steps accordingly. Naturally, everybody would feel a bit happier about the chances of survival of our reserve aircraft and engine factories if they were situated at remote Gretna Green or some place like that, but such an idea is held to be impracticable. The Great War lasted four years, and in its course a great deal of munition work was carried out at Gretna; and if this country ever were involved in another lengthy war many things might be forced upon us which seem out of the question in peace time. Certainly a rapid output of aircraft and aero engines immediately on the outbreak of war would be most desirable, and provision for that is so important as to justify some risk. After all, we cannot be sure that any spot in the United Kingdom will be out of the range of hostile bombers a few years hence.

To consider the possibilities of being bombed is an unpleasant subject, but there are always degrees of unpleasantness. The greatest horror is a deliberate attack on a civil population, and if such an attack were to be made it would almost certainly be made on London. *Flight* has always held that an enemy who neglected military objectives to bomb civilians would be making a mistake in tactics; and it is rather hard to conceive of an intelligent enemy neglecting great centres of munitionment in order to asphyxiate women and children in, say, Streatham or Kentish Town. A sudden cutting off of Britain's supplies of aero engines would have a far more immediate effect on the country's fighting power.

The most comforting news in connection with this problem is that the air defence of the Midlands and North is now being energetically taken in hand. Six whole divisions of the Territorial Army in those parts of the country are being converted to air defence units. A beginning has been made in stationing fighter squadrons to the north of the "inner ring" round London, and we trust that active steps are being taken to establish listening posts of the all-important Observer Corps all along the east coast. The listening posts should extend up to the coast, while the fighter aerodromes ought to be well inland so that the squadrons can strike outwards at raiders instead of trying to pursue them inwards. It should be easy to arrange this.



FOR DESERT SERVICE. During the recent war in Abyssinia some of our bomber squadrons stationed in the desert of the Sudan were temporarily equipped with Vincent aircraft which are specially fitted out for work over the trackless wastes. In this picture we see No. 207 (Bomber) Squadron practising attacks in the Sudan. On return to England the squadron surrendered its Vincents and went back to ordinary Home type bombers.

The Outlook

A Running Commentary on Air Topics

A Supply Minister?

IT is alleged in some quarters that Sir Thomas Inskip, Minister for Co-ordination of Defence, is devoting too much of his time and energies to questions of supply—that instead of considering whether the Territorial Army is giving the R.A.F. exactly the services which are necessary for air defence, whether the design of aircraft supplied to the Fleet Air Arm is always suitable to naval requirements, or whether more Army officers ought to be attached annually to the army co-operation squadrons of the R.A.F. he is too much occupied with numbers of machine guns turned out, and suchlike. The allegations may not be true, but still there is a growing demand among members of Parliament for the appointment of a Minister of Supply.

Generally speaking, this may be a very good idea, but it would certainly be a very bad thing if responsibility for placing contracts for aircraft and aero engines were to be taken out of the hands of the Air Ministry. The present system has been built up by experience, and is on the whole working very well indeed. To disturb it would be a very retrograde step.

That Record

THE Aeronautical Correspondent of the *Morning Post* threw something of a scare into the aviation community last Monday by publishing an article which made it appear that the altitude flight made on September 28 by Sqn. Ldr. Swain in a Bristol monoplane with Bristol Pegasus engine is not a world's record. *Flight's* telephones were ringing all the morning, and anxious voices were asking if it was true. Fortunately, we were able to reassure the enquirers that they need not be alarmed.

As so many were sufficiently interested to ring us up it seems likely that other *Flight* readers are wondering what is the real meaning of the article in question, and for their benefit it may be explained that all records must be submitted to the *Fédération Aeronautique Internationale*, more familiarly known as the F.A.I., for homologation. The F.A.I. publishes every three months an official *Bulletin* containing a list of world's records in the different categories of aircraft. The last to appear included the records homologated up to October 1, 1936. Somewhat naturally, it takes a little time to examine the figures relating to a record, and in view of the fact that Sqn. Ldr. Swain did not make his altitude flight until September 28, it is scarcely surprising that his flight was not homologated in time to be included in this issue of the *Bulletin*.

Misleading

THE heading "British Height Record not accepted" was therefore totally misleading, and the first paragraph of the article did not help to clarify the position by stating that "the height record recently established for Britain by Squadron-Leader F. R. D. Swain does not rank as a world's record."

It is the practice of the F.A.I., and has been for years, to put at the top of the first page of the *Bulletin* a list of what one may term "out-and-out" records, i.e., extremes in any particular performance, irrespective of the class of aircraft which put up the performance. Thus, the altitude record quoted is the American balloon record, because it represents a greater height than has yet been reached by a heavier-than-air machine. The four records listed in this part of the *Bulletin* are: Distance in a straight line, distance over a closed circuit, altitude, and speed over a short straight-line course. It is true that the *Bulletin* terms these four records world's records, while the rest of the records listed are termed Classified International Records, but that is merely a way of distinguishing them from the "out-and-out" records, and certainly does not indicate that they are not world's records.

Uplifting

MENTION was made by Dr. Lachmann in his recent lecture to the R.Ae.S. of the sort of maximum lift coefficients which we may expect to obtain from the various high-lift devices. An interesting confirmation now comes from America, in the form of an article in the October issue of the American *Journal of the Aeronautical Sciences*. The author is Mr. George J. Higgins, of the University of Detroit, and the article gives the results of tests on an aerofoil with slotted flaps carried out in the 7ft. by 10ft. wind tunnel of the University of Detroit.

The tests were made at an Equivalent Reynold's Number of 577,000 on a model wing of 60in. span and 10in. chord. Unfortunately, the author forgets to mention the length of the slotted flap, but it is to be assumed that it was a full-span flap. Its chord was 30 per cent. of the wing chord. The wing section was the Göttingen 398 with the thickness increased 1 per cent.

With the flap set at 45 degrees, the maximum lift coefficient, corrected to full-scale conditions, was 2.12 (or 1.06 in the old British "absolute" units). With the flap at 20 degrees the C_L was as high as 2.07. The most interesting thing about the tests, however, is that the profile drag coefficient is low at fairly high lift coefficients. For example, with the flap set at 20 degrees the minimum profile drag coefficient is only 0.0250, and the remarkable thing is that this low value occurs at a lift coefficient of 1.8. This means that the wing fitted with the slotted flap is very efficient indeed for take-off and for climb at low forward speeds.

On the North-West Frontier

IT has always appeared difficult to get an impartial opinion on the exact value of aircraft in operations on the North-West Frontier of India. The opinions of most commentators have the appearance of being coloured by partiality for their own Service, whether it be the Army or the Air Force, and rather extreme views have been expressed on both sides. A Commander-in-Chief, however, ought to be impartial, for his chief object in life is to protect the Frontier at the least cost in money and lives, and to do this he must (presuming him to be sensible and conscientious) make the most effective use of every weapon which he can command. Especial weight must, therefore, be given to the paper read last week before the Royal United Services Institution by Field Marshal Sir Philip Chetwode, late C.-in-C. in India.

The Field Marshal said that the coming of the air arm was one of the most important developments of recent years in the Indian defence problem. Of its actual utility he said that the reconnaissance machines (i.e., those of the Army co-operation squadrons) were invaluable, for they let the troops know where the enemy was and which heights were held against them. Of the bombers he said that they often dealt successfully with a single troublesome mullah and nipped the trouble in the bud. But when the Frontier was aflame and the laskars were out in force the bombers by themselves could not stop the movement because the tribesmen left their villages to be bombed, hid in caves, and presented no target for the bombers.

To represent Great Britain at Paris : The Bristol Blenheim is believed to be the world's fastest bomber. (*Flight* photograph.)

FIFTEENTH

The Paris Aero Show Opens To-morrow
Czecho-slovakia and America Repr

FROM a technical point of view the possibilities of the Fifteenth International Aero Exhibition, which opens in the Grand Palais des Champs Elysées to-morrow morning, might almost be said to be unlimited. Never in the history of flying has the technique of aircraft construction stood so high; the days of "stick-and-string" contraptions are over, and real engineering has taken their place. Every firm produces all-metal aircraft, with the exception of the few which cater for the private owner or light-plane enthusiast exclusively. The art of designing and building aero engines has improved very materially, with the result that power has gone up and weight down. Reliability, once a doubtful quantity, is now taken for granted. Materials, equipment and accessories are better and more numerous than ever before.

It is, of course, always true of any aero show that it is not truly representative of the art. Military aircraft types have ever formed a large percentage of the total, and no air ministry is willing to release for public exhibition all the very latest types. Consequently, the military aircraft shown are bound to be, in most cases, types produced before the show, and therefore mostly already known. This fact tends to rob the show of the surprise element.

Civil Preponderance

On the other hand, at the Paris Aero Show two years ago the military aspect was far from overpowering; at any rate in the matter of actual numbers, a total of approximately seventy aircraft containing but twenty-one military types. It seems likely that approximately the same proportion will be found at this year's exhibition.

Political obstructions to a really representative show have been at work this year. Doubtless the absence of Germany and Italy has a political basis, whatever official explanations may be given. The products of these two countries will be greatly missed, and their absence is bound to rob the show of a great deal of interest.

Within France itself it seems that many names famous in French aviation are absent from the list of exhibitors. Particularly will the name of Louis Blériot be missed by all who have made a habit of visiting the French aero shows over a period of many years. We believe we are right in saying that 1934 was the first time Louis Blériot was not represented, and the thought that the great pioneer has passed out of our ken for ever will cast a shadow over the gay interior of the Grand Palais. Another very old-established French firm, that of Pierre Levasseur, is absent this year.

In addition to Blériot and P. Levasseur, one misses such famous names as C.A.M.S., Gourdou-Leseurre, P. Latécoère, Morane-Saulnier and S.P.C.A. It seems likely that the nationalisation of aircraft factories, recently decided upon, may have been in some degree responsible for these absentees. This is to be regretted, as their products always lent interest to the Paris Show.

In spite of the fact that nearly all the British aircraft and aero engine factories are very full up with work, Great Britain will be very well represented, qualitatively if not quantitatively, at the Paris Aero Show. The Bristol Aeroplane Co., Ltd., true to a tradition which began almost with the foundation of the company, will be represented not only by a very fine range of aero engines, including the Mercury, Pegasus, Aquila and Perseus, but also by a most interesting modern aeroplane, the new Blenheim twin-engined bomber. This machine is probably the fastest of its class in the world, and is bound to attract a great deal of interest for this reason, even if actual performance figures cannot be quoted.

It is to be greatly regretted, although not, perhaps, very surprising, that the British Air Ministry has withdrawn its permission to show the Hawker Hurricane single-seater fighter with Rolls-Royce Merlin engine. The

machine is, of course, of very advanced type, both in aerodynamic design and in its structural features, as well as in the matter of armament and general military equipment. A general-purpose day and night fighter of this type would undoubtedly have appealed tremendously to the more discriminating visitors to Paris, but they will have to rest content with an examination of photographs of it. Specimens of typical Hawker construction will be shown.

In addition to the Bristol engines already mentioned, British aero engine firms will be represented as follows: Armstrong Siddeley Motors, Ltd., by two Cheetah IXs, one of which will be shown fitted with Ratier constant-speed variable-pitch airscrew, and a Tiger IX; Cirrus-Hermes Engineering Co., Ltd., by a Cirrus Minor and a Cirrus Major, Mark II; and Rolls-Royce, Ltd., by a Kestrel VI and Kestrel XVI, and last, but not least, by a Merlin, the new high-power R.R. engine which is being fitted in so many of the latest types of military aircraft. British plugs will be represented by such world-famous names as K.L.G. and Lodge.

Britain's contribution of aircraft instruments to the Show will be in the hands of Smith's Aircraft Instruments and Short and Mason; Standard Telephones and Cables, Ltd, will exhibit wireless transmitting and receiving sets; while H. M. Hobson, Ltd., will show the progress this country has made in the matter of engine accessories such as carburetters, boost controls, and other automatic controls which save the modern aero engine and make the pilot's life a little easier.

Gallay, Ltd., will show radiators, oil coolers, cabin heaters, and tanks.

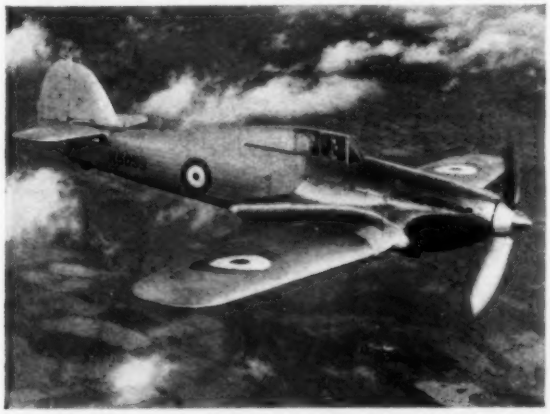
Wheels and tyres play a very important part in the life of an aircraft, and the examples to be shown by the Dunlop and Palmer companies will worthily uphold British pres-

of the SERIES

: France, Great Britain, Holland, Poland, sented : Germany and Italy Absent

tige in this direction. Aircraft Components, Ltd., will have an exhibit representative of the wide range of undercarriage and wing flap retracting gear upon which Mr. G. H. Dowty has specialised for several years, and the internally sprung Dowty wheel, so useful for fitting on non-retracting undercarriages, is bound to attract attention.

So small that they are easily overlooked when examining an aeroplane are many of the Simmonds "Aerocessories,"



Originally the Hawker Hurricane was to have been shown at Paris, but Air Ministry permission has been refused. (*Flight* photograph.)

An interesting project is the Hanriot monoplane of which this is the scale model.

but at Paris they will be on view in an attractive form, calculated to demonstrate the importance of little things. The new Simmonds-Theed vacuum control will also be on view.

Lubrication has ever been one of the essentials to good and smooth running of any machinery, and the aeroplane with its engine is no exception. Tecalemit, Ltd., will show the range of equipment which has made the name famous throughout the aircraft world for many years.

French Aircraft Exhibits

An interesting exhibit will be the new Amiot long-range postal aeroplane, type Amiot 341. This is a very clean twin-engined cantilever monoplane, which will be available with two Hispanos or two Gnome-Rhone engines. A speed of close upon 300 m.p.h. is claimed for this machine.

Marcel Hanriot, whose father was one of the pioneers of French aviation, will exhibit a mid-wing braced monoplane, type H.220, which is a three-seater military type incorporating all the latest improvements such as supercharged engine, retractable undercarriage, flaps, and so forth. When fitted with air-cooled engines of 500-600 h.p. the speeed is claimed to be about 300 m.p.h.

Two machines will probably be exhibited by the Loire-Nieuport company. One is the Loire 46 single-seater fighter with air-cooled engine (any type between 700 h.p. and 1,100 h.p.) and the other a Loire 250, which is also a single-seater fighter, but a low-wing monoplane, whereas the Loire 46 is a strut-braced gull-winged type. The 250 has a Hispano 14Ha air-cooled engine, and is credited with about 300 m.p.h.

Lioré & Olivier will exhibit but one full-size machine, the LeO C.34 Autogiro, but will show scale models of a number of aircraft types, including the LeO 46 seaplane fighter, the LeO 246 commercial seaplane, and the LeO H.47 trans-atlantic flying boat.

Henry Potez will show one full-size machine and a number of scale models. The machine is the Potez 63, which is a twin-engined general-purpose military type, fitted with two Hispano 14 Hbs air-cooled engines, with which it is said to attain 310 m.p.h.

The light-plane field will be looked after by two French firms, of which S.F.A.N. will exhibit the S.F.A.N.4, which is a two-seater version of the Kronfeld Drone. S.C.A.L. will show a little pusher monoplane similar to that on which Col. Fitzmaurice flew from Paris to London recently.

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

TWIN-SCREW. The Koolhoven single-seater fighter to be shown at the Paris Salon has two airscrews revolving in opposite directions.

THE Danish Army Air Force is shortly sending a commission of four to this country.

The Westland Army-co-operation monoplane has been taken off with full load in 120 yards and landed in 100 yards.

Groups of trees in the shape of shields, the points of which will face south-west, are to be planted as landmarks for airmen.

Each of the three "official" French entries for the Paris-New York race next spring will have four Hispano-Suiza engines.

The Beechcraft which, flown by Louise Thaden and Blanche Noyes, won this year's Bendix Trophy race, has been sold to the Honduras Government.

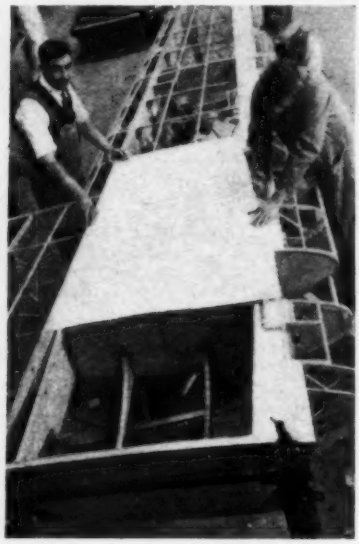
The French Air Ministry announces that units of "air infantry," using parachutes as a tactical weapon, are to be formed. This scheme was introduced by Russia.

Two-hundred Aeroncas have been ordered from the Aeronautical Corporation of Great Britain for delivery by next March. This will mean an eventual weekly output of fifteen machines.

The following estimated figures relate to Capt. Frank Hawk's new high-speed monoplane: Top speed at sea level 375 m.p.h., cruising speed (13,000-15,000ft.) 340 m.p.h., initial rate of climb 7,000ft./min., landing speed 68 m.p.h. and terminal velocity speed 750 m.p.h.

Sikorskys announce the completion of designs for a 50-ton flying boat for trans-atlantic service. There is accommodation for 35 passengers in a number of staterooms and what an American contemporary terms a dancing pavilion. The engines will be eight 1,150 h.p. Twin Wasps.

A number of Bristol Blenheim high-speed medium bombers have been ordered by Australia. It is reported that there will be at least one squadron of twelve machines with a reserve of the same number.



AIRSPEED INNOVATION. The new Series III Airspeed Envoy incorporates stressed-skin, plywood-covered wings of simplified construction. This view shows one of the first "going through."

The mass production of a device claimed "to keep an airscrew going after engine failure has occurred" may provide work for at least two hundred men on the Teams Valley Trading Estate, Gateshead.

Mr. L. E. Clark, the New Zealand farmer who left England for home on October 26 in a Percival Gull, arrived at Port Darwin, Australia, a week ago.

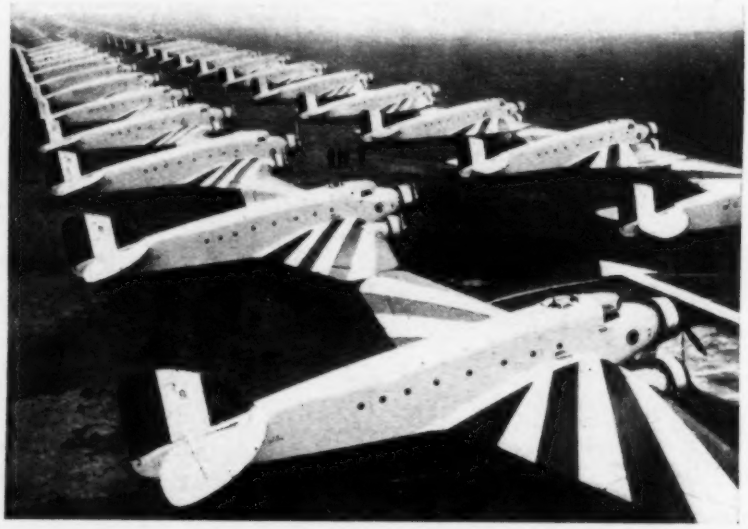
Finland is to have twelve new British bombers. The Finnish Government are reported to have completed negotiations for their delivery before Christmas, and a lump sum of £250,000 is quoted in connection with the deal.

Irish Hospitals Trust, claiming that the Bellanca monoplane used by Mr. James Mollison to cross the Atlantic was their property, sought an injunction to restrain Mr. Mollison and Rollason Aircraft Services from using the machine. But "as a gesture from sportsmen to a fine sportsman" they relinquished any right against Mr. Mollison to claim the machine.

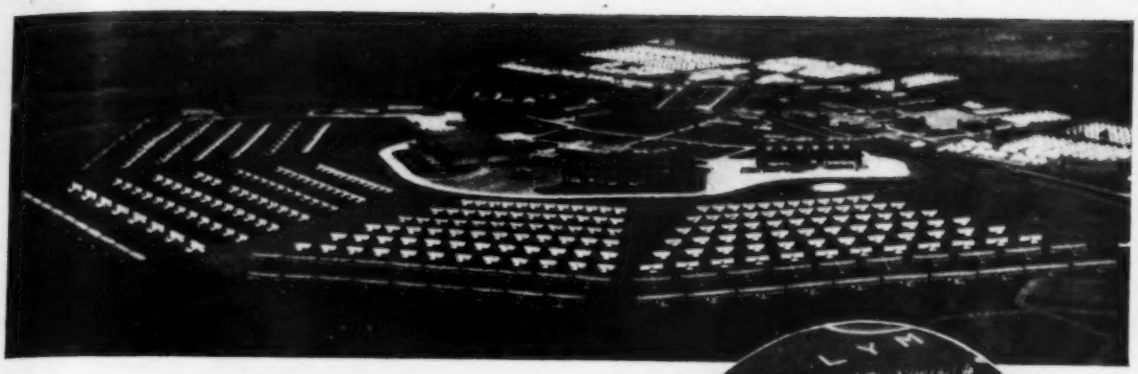
Twenty-five Years Ago

(From "Flight" of November 11, 1911.)

"In a Dundee journal, a correspondent who signs himself 'Terra Firma' asks: 'Is it moral, by the bait of considerable sums of money and of prizes, to lure young men, fiery with intrepidity, to a death, if not certain, at least very probable?' 'Is it not cruel to tempt foolhardy men to their deaths by these gilded baits?' 'Are we to demand gladiatorial sacrifice from our aviators?'"



THE BIG PARADE. Savoia Marchetti S.81 long-range bombers, with variegated craft beyond, looking pretty for Il Duce at the Lonate Pozzolo airport, near Milan.



THE BRITISH AIRCRAFT INDUSTRY

An Aero Show on Paper

THIS week's issue of *Flight* is devoted almost entirely to a review of the British aircraft industry. It is produced deliberately to coincide with the Fifteenth International Aero Exhibition, to be held in Paris from Friday, November 13 to Sunday, November 29, so that readers of *Flight* throughout the world may have an opportunity to become familiar with every sphere of British aeronautical industrial activity.

It was obviously impossible for all the firms of which the British aircraft industry is composed (nearly 300) to take place at the Paris Aero Show, and when *Flight* announced its intention to publish a special issue in which the products of the industry would be dealt with the response was excellent. Thanks to the co-operation of all the firms, the result has been that this week's issue forms a very complete guide to the very wide range of aircraft, aero engines, materials, instruments, accessories and equipment which the British aircraft industry as a whole has to offer.

Since *Flight* published its previous annual issue devoted to the British aircraft industry, on December 5, 1935, the R.A.F. expansion scheme has got well under weigh, and the result is, to some extent, reflected in the number of firms whose products are described in the present issue. An examination of the different sections indicates that there are now more than thirty British firms which produce aircraft, some thirteen manufacturing aero engines, and approximately 240 companies engaged in one branch or another of the multifarious ramifications of the industry generally.

A few words of explanation of the plan upon which this issue is based may be of assistance to readers in finding rapidly any product in which they may be particularly interested. Aircraft and aero engines will be found on the following pages:—

British civil aircraft types 488-497
British military aircraft types .. 508a-514
British aero engines 500-507

Materials, accessories, instruments and equipment are reviewed on pp. 516-535. Each of the firms whose products are dealt with has been given a series number, and in the tables on page 535 will be found, classified under subjects, an index to the series numbers of firms. In this way, reference to any particular product will be facilitated and the value of this issue of *Flight* as a reference volume enhanced.

THIS ISSUE OF

FLIGHT
THE AIRCRAFT ENGINEER AND AIRSHIPS

DEALING as it does with the products of over 300 firms in considerable detail, this issue of *Flight* forms a valuable work of reference and index to the British aircraft industry.

For the information of new readers, it should be pointed out that the constitution of this special number is not typical of ordinary issues, which, in addition to the regular features such as Commercial Aviation, Club News, and Royal Air Force Notes, contain fully illustrated articles on various aviation subjects of topical interest, together with latest news of the industry.

Features of this issue will be found on the following pages:—

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BRITISH CIVIL AIRCRAFT

A flying boat of the Short Empire class ; the acme of marine aircraft construction.

Machines for Private and Commercial Use

Illustrated Mainly with "Flight" Photographs

IN variety the range of British civil aircraft is unrivalled. Designers are keeping abreast of foreign competitors in practically every development calculated to benefit modern civilian types, and in more than one field can show products undeniably superior to anything offered abroad.

A number of highly efficient designs are in the development stage, while construction is in progress on some types of exceptional promise.

ABBOTT-BAYNES

THE most notable Abbott-Baynes development up to the present is what the manufacturers, who build their machines at Heston Airport, Middlesex, term the Cantilever Pou. Although founded on the recommendations of M. Henri Mignet this model has a new design of structure, eliminating all wires and consequently, it is claimed, the previous weakness of the Pou consequent on the absence of anti-lift wires.

Priced at £189, the Cantilever Pou is fitted with a water-cooled Carden engine of 30 h.p., has a maximum speed of 80 m.p.h. and shows an initial rate of climb of 400ft./min.

Other developments, which are not being publicised at the moment, are under way.

AERONCA

SUBSTANTIAL orders are being received by Aircraft Exchange and Mart, Ltd., the managing distributors of the machine, for the £395 Aeronca-J.A.P. light two-seater monoplane which, in a few months, has gained great popularity in Great Britain for training and touring.

This type of aircraft—a wire-braced model with side-by-side seating—originated in America, but is being built in this country by the Aeronautical Corporation of Great Britain.

On the power of the 38 h.p. J.A.P. air-cooled engine the standard Aeronca is capable of 95 m.p.h., while the landing speed is as low as 33 m.p.h.

AIRSPEED

ON the civil side of its business this Portsmouth company, which specialises in the construction of high-performance commercial aircraft, is concentrating its attention on two models, the twin-engined Envoy and single-engined Courier.

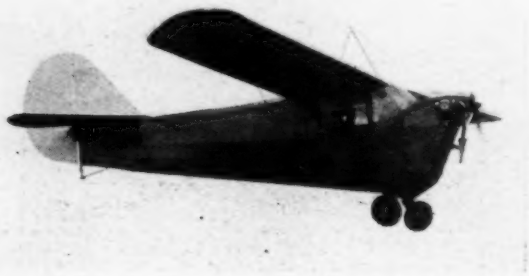
Although the Courier is a few years old it is still popular where a fast machine with a disposable load of 1,500 to 1,700lb. is required. The engine normally specified is the Siddeley Lynx IVc, which gives a maximum speed of 153 m.p.h., although the more powerful Cheetah V and the American Wright Whirlwind are alternatives.

The company has just announced an improved version of the Envoy light transport, which differs mainly from the firmly established Series II model in that its wings have been redesigned. Stressed-skin plywood covering is employed, obviating the Warren-girder bracing between the spars.

Cabin schemes for the accommodation of any number of passengers up to eight have been prepared.

Fitted with Siddeley Cheetah IX engines the maximum speed is 205 m.p.h. at 7,300ft., and the service ceiling is 22,000ft. A single-engine ceiling of 6,250ft. is claimed. Alternative power plants are the Walter Castor II, Wright Whirlwind R.760.E.2, Gnome Rhone 7K.D or 7K.F.S. (in the latter case the top speed is no less than 225 m.p.h.) and Wolseley Scorpio.

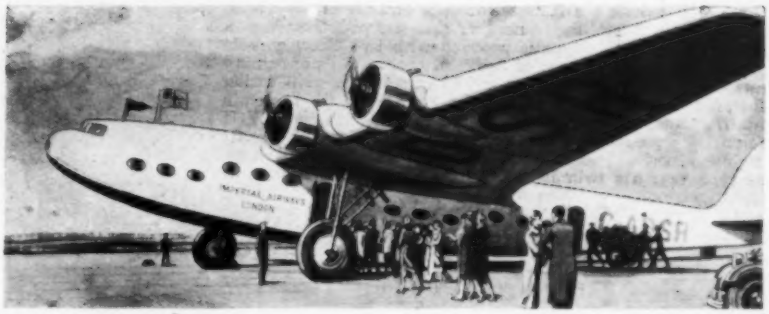
The Abbott-Baynes Cantilever Pou with 30 h.p. Carden engine.



Large orders have been placed for the Aeronca light two-seater.

This particular Airspeed Envoy has just been delivered to the Maharajah of Jaipur.

The sketch below gives a rough idea of the layout of the A.W.27 (four Tiger IX) for Imperial Airways.



ARMSTRONG WHITWORTH

TWELVE large four-engined monoplanes are being built at the Whitley (Coventry) works of Sir W. G. Armstrong Whitworth Aircraft, Ltd. Designed expressly for operation on the European and Empire routes of Imperial Airways, these machines, designated provisionally A.W.27s, are of high-wing type with 795 h.p. Tiger IX engines driving De Havilland variable pitch airscrews.

The wings are built on a single box-spar and taper in plan form and thickness. Metal covering is used for the leading edge, part of which serves to cool the oil tanks. Aft of the spar the wing consists of a lattice structure of rolled light-alloy sections, the covering being fabric. Split trailing-edge flaps are fitted and the mass-balanced Frise ailerons have automatic servo flaps. The flap on the port aileron can be used to trim the machine laterally.

An oval monocoque structure of light alloy, the fuselage incorporates stress-bearing skin.

Each half of the undercarriage is retractable hydraulically into the inner engine nacelles and behind the spars.

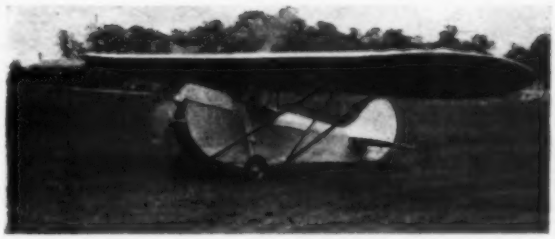
Dual control is provided for the captain and first officer. A wireless operator and two stewards complete the crew. Aft of the control cabin the fuselage is divided into cabins, there being four in the "European" (42-passenger) class and three in the "Empire" class. The latter model accommodates 27 passengers by day or twenty by night, with sleeping arrangements. In both types there is a kitchen, but the European class has three lavatories whereas the Empire model has two. There is a capacious hold for mails and luggage.

The main dimensions are: span 123ft., length 110ft., and height 23ft.

BLACKBURN

THE prototype of a twin-engined high-speed civil monoplane known as the H.S.T.10 is flying at the Brough (E. Yorks) aerodrome of the Blackburn Aeroplane and Motor Company. This model has Napier Rapier VI moderately supercharged "H" type engines giving a maximum speed of 200 m.p.h.

The wing is of the Duncanson single-spar patented type incorporating a spar of tubular form which is employed as the fuel tank.



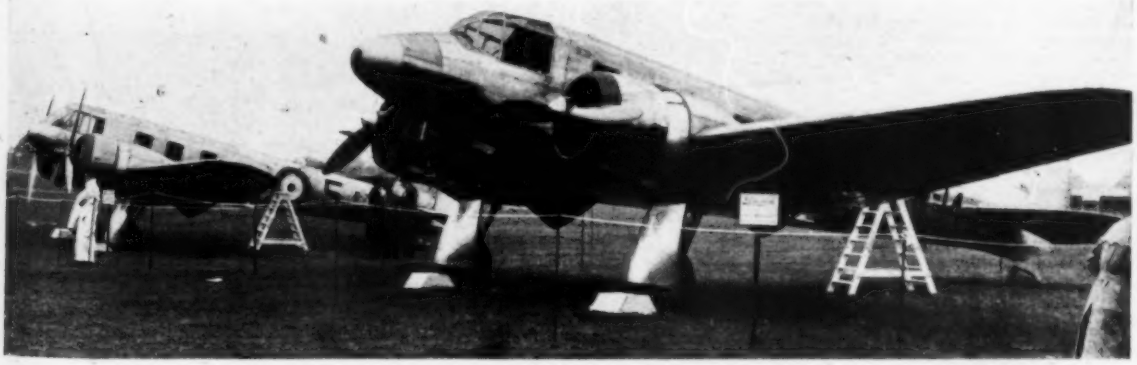
The Broughton Blayney Brawny light monoplane, which is now on a 3,000-mile tour of the British Isles.

BOULTON PAUL

TWO feeder-line biplanes of the P.71/a type have been supplied by this Wolverhampton firm to Imperial Airways, Ltd. On the power of two Siddeley Jaguar VI.A engines this type cruises at 150 m.p.h. A machine of similar design but fitted with 690/750 h.p. Bristol Pegasus IIIs has also been designed.

BROUGHTON BLAYNEY

PRODUCTION of the Brawny ultra-light monoplane was started at Hanworth, Middlesex, just over three weeks ago by the Broughton Blayney Aircraft Company, Ltd. The



Nearest the camera is the twin-Aquila Bristol 143 civil monoplane and beyond it the 142 Britain First with two Mercuries. The latter is the fastest commercial machine ever built.

company is now in a position to quote three-weeks' delivery of this fascinating little aeroplane.

The Brawny sells for £195 and is a strut-braced parasol monoplane mounting a 30 h.p. water-cooled Carden. With a speed range of 35-68 m.p.h., and a fuel consumption of 2 gal./hr., the machine is an attractive proposition for clubs and enthusiasts.

BRISTOL

ALTHOUGH none of the products of the Bristol Aeroplane Company, of Filton, Bristol, are in regular commercial use (Government orders having inundated their works), this company has built the fastest transport aircraft in the world.

Bearing the Bristol works number 142, and popularly known as *Britain First*, this type is powered with two Mercury VIII fully supercharged engines of 840 h.p. each. On preliminary tests the machine showed a speed of 280 m.p.h. with earlier Mercuries of only 605 h.p., and it is believed that certain improvements, the chief being the re-engining with Series VIII Mercuries, have resulted in a maximum speed in the immediate neighbourhood of 300 m.p.h. A somewhat similar machine, the type 143, has twin Bristol Aquila sleeve-valve engines of 500 h.p.

(Above)

A type combining extreme safety with lively performance: the B.A. Swallow.

(Left)

Newest of the B.A. types: the twin-Gipsy Six Double Eagle high-speed light transport.

BRITISH AIRCRAFT

EXCEPTIONAL safety is, perhaps, the chief virtue of the little B.A. Swallow two-seater low-wing monoplane, orders for which have been keeping busy the Hanworth (Middlesex) factory of the British Aircraft Manufacturing Co., Ltd. This attractive little machine is now available with the Pobjoy Cataract III or Cirrus Minor engines, each of 90 h.p. Either unit gives a cruising speed of 92 m.p.h., but with the Pobjoy the full-load take-off run (50 yards) is 5 yards shorter and the initial rate of climb (800 ft./min.) 100 ft./min. higher. On the other hand, the Cirrus Minor permits a range of 390 miles (against the 355 miles of the radial engined version) and a pay-load of 212lb., or 32lb. more than with the Pobjoy. With the latter engine the price is £725.

Swallows are popular alike with clubs and private owners for training and touring.

A second type, the Eagle three-seater cabin monoplane, is normally fitted with the 130 h.p. D.H. Gipsy Major engine. The undercarriage may be arranged to retract laterally into the cantilever wing or can be fixed, in which case, of course, it is well faired. The cruising speed with undercarriage retracted is 130 m.p.h. This type sells for £1,250.

The very latest B.A. model has two engines and is characterised by the anhedral angle on the inner sections of its wings. Performance tests with this machine—a six-seater with retractable undercarriage—are not completed, but with two Series I D.H. Gipsy Sixes of 200 h.p. each it is believed that a maximum speed of at least 195 m.p.h. is obtainable.

CIERVA

THE latest development by the Cierva Autogiro Company, Ltd., of Bush House, Aldwych, London, W.C.2, is the "Autodynamic" direct take-off machine, the main fuselage structure of which is similar to that of the well known C.30 type. The new model, however, differs from its predecessors in that it is designed to take-off and land with no forward run whatsoever. Numerous advantages come readily to mind.

For direct take-off the two rotor blades move automatically to substantially zero pitch when the rotor clutch is engaged. In this position the blades are rotated to a higher speed than is required for normal flight, and when the clutch is released they automatically increase their pitch. This sudden change in pitch produces lift in excess of the weight of the machine, which, as the makers put it, "is projected into the air in a vertical direction."

In flight the rotor is driven by the relative wind, only the airscrew being driven from the Siddeley Genet Major engine. The speed of the blades remains substantially constant from top speed to vertical descent.

On touching the ground the application of a rotor brake decreases the blade pitch to zero and prevents the machine from overturning.

The "Autodynamic" Autogiro which is capable of direct take-off.

Structurally the new C.L.W. Curlew trainer is of exceptional interest.

C.L.W.

A POBJOY-ENGINED light training monoplane marks the entry of the C.L.W. Aviation Co. (1936), Ltd., of Gravesend Airport, Kent, into the field of British aircraft construction. Completed a few months ago, described in *Flight* of Sept. 17, and known as the Curlew, the machine has been planned for the instruction of pilots who will pass eventually to clean, high-performance monoplanes with high wing loadings. Any engine of up to 130 h.p. may be specified, the Niagara III giving a top speed of 127 m.p.h. With flaps down the Curlew lands at 40 m.p.h. in spite of the fact that it is loaded to 14 lb./sq. ft. A terminal velocity speed of 305 m.p.h. was attained during diving tests.

DE HAVILLAND

THE current models in production at the Hatfield (Herts) factory of the De Havilland Aircraft Co., Ltd., are the 86a four-engined transport, the Rapide, a smaller twin-engined model, the Dragonfly, which is eminently suitable for light commercial work, as a private owner's "luxury" machine or for training in flying twin-engined machines, the tiger Moth training biplane (dealt with on page 509 of this issue) and the Hornet Moth, a light biplane with side-by-side seating popular alike with private owners and clubs.

There is widespread discussion in the industry and among commercial operators about the Albatross, or D.H.91, which should be flying early in 1937. A low-wing monoplane for long-range inter-Continental work, this machine has four of the new D.H. Gipsy Twelve inverted vee air-cooled engines, each capable of delivering over 500 h.p. to De Havilland variable pitch airscrews.

Although designed primarily for trans-Atlantic mail carrying, the Albatross can also be arranged to carry a considerably larger number of passengers than any previous D.H. design and to provide spacious and luxurious accommodation with such added comforts as the provision of light meals on board and arrangements for conversion to a sleeper for night travel. The cruising speed is expected to be at least 200 m.p.h.

The latest D.H. 86a, with D.H. Gipsy Six Series II engines and D.H. variable pitch airscrews, has a cruising speed at 7,000 of 160 m.p.h. The maximum speeds of the Rapide (two Gipsy Six Is), Dragonfly (two Gipsy Majors) and Hornet Moth (Gipsy Major) are respectively 157 m.p.h., 148 m.p.h. and 124 m.p.h.

Three popular De Havilland biplanes: from top to bottom, the 86a transport machine with four Gipsy Six engines, the Gipsy Major-powered twin-engined Dragonfly for the private owner and light commercial work, and the Hornet Moth (Gipsy Major), a side-by-side two-seater for private or club use.

DART

FOUNDED in 1934 under the name of Zander and Weyl, Dart Aircraft, Ltd., of 29, High Street N., Dunstable, Beds, have built several sailplanes, *Poux* and replicas of historical aircraft.

Two ultra-light aeroplanes—the Pup and Flittermouse—are already flying, and a third, christened the Kitten, is nearly ready for preliminary tests. The Pup is a single-seater pusher designed to take a 34 h.p. engine and is by no means a powered glider, whereas the Flittermouse (25 h.p. Scott), likewise a single-seater pusher, shows a much lighter wing loading, having been built to meet special requirements.

The Dart Pup is an interesting ultra-lightweight pusher parasol monoplane.

The Kitten has been planned as a pusher and is a low-wing single-seater model, with a 25 h.p. Ava engine, intended for the private owner and for the solo training of pupils with a few hours' solo flying to their credit.

GENERAL AIRCRAFT

HAVING met with great success in the design and construction of small twin-engined metal monoplanes, General Aircraft, Ltd., of Hanworth, Middlesex, are now offering in addition to its S.T.25 and Ambulance models (twin 90 h.p. Pobjoys) the Croydon high-speed ten-passenger transport.

Like previous machines of the company, this model has a single-spar wing of patented Monospar construction. Although the prototype was fitted with two American Pratt and Whitney Wasp Junior radials of 400 h.p. each, a variety of power plant installations is available. The Croydon incorporates a number of unusual design features, including a pronounced sweep back on the wings, introduced to avoid sudden stalling. The undercarriage is retractable and variable pitch airscrews are utilised.

At a cruising speed of about 190 m.p.h., the Croydon has a range of 650-700 miles with ten passengers.

The S.T.25 carries a pilot and four passengers at 125 m.p.h. with its twin Pobjoy Niagara III engines throttled back to give 77 per cent. of their maximum power. In its latest form it has twin rudders which effect an improvement even over the flying characteristics of the older single-rudder model. The undercarriage is a sturdy, simple, divided type.

Developed directly from the standard S.T.25, the Monospar Ambulance is of similar construction and has the same power plant installation. The internal layout was planned under the auspices of the British Red Cross Society.

HILLSON

PRODUCTION of an English-built version of the Czechoslovakian Praga Baby two-seater light monoplane is in progress at the Trafford Park (Manchester) works of F. Hills and Sons, Ltd. The Praga has a high cantilever wing and side-by-side seating and, fitted with a 36 h.p. Praga flat-twin engine, does 93 m.p.h. The price is £385.

HESTON

COINCIDENT with the preparation of this issue, the Heston Aircraft Co., Ltd., of Heston Airport, Middlesex, have announced that they have built, to a design proposed by Mr. Hordern, their test pilot, and to the specification of the Duke of Richmond and Gordon, to whose private order the machine was built, a small twin-engined two-three-seater monoplane.

Two American Continental A/40 flat-four air-cooled engines are fitted on the wings, and the pilot and passenger are seated side-by-side in the extreme nose of the fuselage. The take-off is quite superlative, and preliminary tests indicate pleasant handling qualities. The "occasional third" seat may be used if the 160lb. of baggage provided for is not required. It is understood that an interesting control system is installed. The machine should be put into commission in about four weeks, when the Duke of Richmond will be happy to show it to other enthusiasts.

The Phœnix high-wing monoplane, the first model to be put on the market by the company, is a five-seater high-wing strut-braced monoplane with a Gipsy Six 200 h.p. engine, which gives a top speed of 148 m.p.h. The noise level in the cabin is 70-74 decibels.

KRONFELD

KRONFELD, LTD., of Hanworth, Middlesex, are now in production with two ultra-light monoplanes designated the Super Drone and the Drone de Luxe, and priced respectively £275 and £325. Both are essentially single-seater, single-

The upper machine is the latest version of the Monospar S.T.25 which has twin rudders and two 90 h.p. Pobjoy Niagara III engines. The Croydon high-speed transport beneath it is capable of over 200 m.p.h.

On the left is the little Hillson Praga two-seater cantilever monoplane which has side-by-side seating.

engined parasol monoplanes equipped with pusher airscrews.

It has been estimated that, assuming a pilot or club does 400 hours' flying annually and the machine is completely written off in four years, the running cost of the Super Drone, including depreciation, petrol and oil, full comprehensive insurance (third-party and crash), housing and maintenance, will be no more than ten shillings per flying hour, or twopence a mile at 60 m.p.h.

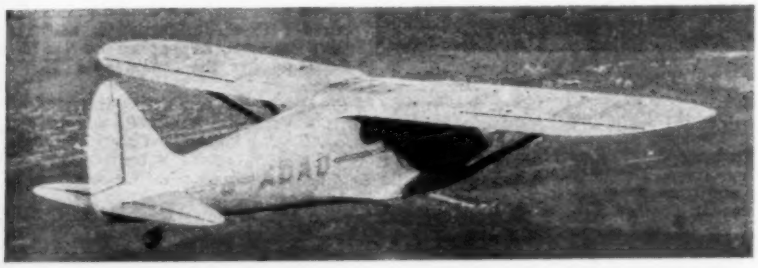
The Super Drone has a 750 c.c. Aero Engine power plant and is claimed to land and take-off in 45 yards. A 28 h.p. water-cooled Carden gives the Drone de Luxe a cruising speed of 62 m.p.h

LUTON

ONE of the most attractive ultra-light machines which have appeared during the past few months is the £325 Luton Buzzard, an eyeable little monoplane built at Gerrards Cross, Bucks, by Luton Aircraft, Ltd. Split flaps, "trousered" undercarriage and pusher airscrew are features, and the speed range is from 25-85 m.p.h.

Very recently the company has issued preliminary details of the Minor, a machine in the design of which safety has been the first consideration. The speed range is estimated to be from 22 m.p.h. to 75 m.p.h. with the 34 h.p. Anzani engine, and the provisional price £225. The Minor might be described as a biplane with exceptional stagger. Ailerons are fitted to the lower, or rear, wings only, and, thanks to the slot effect produced by the relative positions of the main planes, they should remain effective up to and beyond the normal stalling attitude. This slot effect is claimed also to eliminate the undesirable stall and involuntary spin.

The forward portion is reminiscent of a *Pou du Ciel*.



A striking "angle" on the B.A.C. Super Drone which cruises at 60 m.p.h. with a 750 c.c. engine.

Although showing unusual economy the Heston Phoenix (D.H. Gipsy Six) has an excellent all-round performance.

A two-three-seater twin-engined monoplane of intriguing design : the new Heston monoplane with two Continental A 40 engines.

PARNALL

FULL use is made in the Parnall Heck two-seater low-wing monoplane of leading-edge slots and trailing-edge flaps, resulting in an unusually wide speed range with a 200 h.p. D.H. Gipsy Six engine.

The manufacturers are Parnall Aircraft, Ltd., of Yate, Gloucestershire, and the sole concessionaires are Aircraft Exchange and Mart, Ltd., of 7, Park Lane, London, W.

PERCIVAL

THOUGH the first is a single-seater, the second a three- and the third a four-seater, the Percival Mew Gull, Gull and Vega Gull all bear the Percival stamp, having low cantilever wings and fixed "trousered" and "spatted" undercarriage. All are of wooden construction and embody an effective flap gear.

The Mew Gull is intended for the sportsman pilot or as a fast, light despatch carrier, and is normally fitted with a D.H. Gipsy Six. The latest models built mount the Series II version of that engine driving a variable pitch airscrew, and their cruising speed is well above the 190 m.p.h. claimed for the machine with the Series I "Six."

The Gull, with a batch of records to its credit, can be supplied with the D.H. Gipsy Major or Gipsy Six engine, the respective maximum speeds of the two versions being 154 m.p.h. and about 180 m.p.h. Their pay loads 515lb. and 455lb., and their ranges 745 miles and 640 miles.

Seating four in quite surprising comfort considering its size (span 39ft. 6in. and length 25ft. 6in.) the Vega Gull, like the Mew, has lately been produced with the Series II Gipsy Six and thus powered a Vega Gull, flown by C. W. A. Scott and Giles Guthrie won the recent Schlesinger race to Johannesburg. The Vega bids fair to emulate the Gull as a record-breaker. With the Series I Gipsy Six the Vega Gull cruises comfortably at 150-155 m.p.h., but the newer engine adds several m.p.h.

Space does not permit a list of records and long-distance flights standing to the credit of Percival machines, but in a short period the various types have covered themselves with glory.

Such refinements as split flaps, wing root fillets and trousered undercarriage are incorporated in the ultra-light Luton Buzzard pusher.

The Percival Mew Gull illustrated has one of the new Series II Gipsy Six engines. A similar unit powers the four-seater Vega Gull beneath it.

PHILLIPS AND POWIS

RANGING in size from the Sparrowhawk to the Peregrine by way of the Hawk types, Whitney Straight, Falcon, Nighthawk and Merlin, the Miles series, produced by Phillips and Powis Aircraft, Ltd., of Woodley Aerodrome, Reading, covers a wide number of sporting, training and commercial requirements. All are cantilever monoplanes of wooden construction bearing a distinct family resemblance to each other.

The Sparrowhawk is normally built as a single-seater and is capable of 175 m.p.h. with a D.H. Gipsy Major engine.

Similar to each other in appearance, the Hawk Major and Hawk Trainer differ mainly in that the latter has a greater wing area. With the 130 h.p. Gipsy Major the maximum speed of the Trainer is 145 m.p.h.

An attractive side-by-side two seater, the Whitney Straight, with Gipsy Major engine, is selling well.

The Falcon and Nighthawk are normally powered with the Gipsy Six and, although similar in external appearance, are planned for distinct duties. The former is a three-seater machine suitable for the private owner who wants high all-round performance, whereas the 175 m.p.h. Nighthawk has been laid out as an instructional type.

The Merlin cabin monoplane has a payload of 708lb. with a Gipsy Six engine.

Latest and largest of the P. and P. programme is the 180-m.p.h. Peregrine light, twin-engined transport, powered with Series II Gipsy Sixes and fitted with variable pitch airscrews and retractable undercarriage. The disposable load is 2,200lb.

All current designs incorporate the efficient Miles split trailing-edge flaps.

The Mohawk, a high speed long-range tourer, has lately been completed to the order of Colonel Lindbergh.

POBJOY

TO carry a disposable load of 1,000lb. at a speed of 115 m.p.h. with two Pobjoy Niagara III 90 h.p. engines throttled back to cruising r.p.m. is quite an achievement, but that is the performance of the Scion monoplane, designed by Short Bros., and handled by Pobjoy Airmotors and Aircraft, Ltd., of Rochester, Kent.

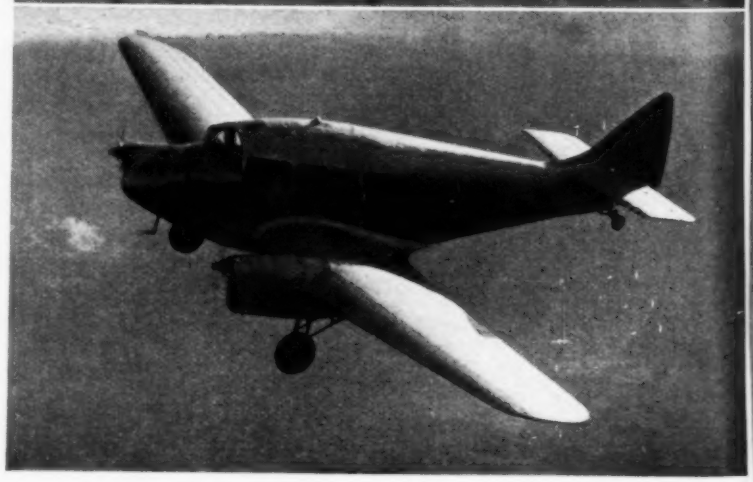
The Scion is a high-wing cantilever monoplane suitable for wheel or float undercarriage, and is normally arranged as a six-seater. A military version of the Scion, suitable for second-class warfare, police and customs patrol work and punitive expeditions, has been designed. Light bombs and a Lewis gun can be carried.

AVRO

AFTER Imperial Airways, Ltd., had taken delivery of two Avro 652 monoplanes a military development of this type was adopted by the Royal Air Force under the name Anson. This machine incorporated certain aerodynamic and structural alterations as compared with the original 652, and these have lately been applied to the civil machine at the company's Newton Heath (Manchester) works.

The new version of the 652 is now completing tests and performance figures have not yet come to hand. Considering that, with two Siddeley Cheetah IX radials the older model did 195 m.p.h., a brilliant performance is anticipated. An improved tail and modified engine nacelles and cowlings are features.

For civilian training the Avro Genet-Major engined Cadet is still extremely popular.



Side-by-side seating and pleasant handling characteristics are popularising the Miles Whitney Straight (above). The Miles Peregrine light transport (below) has two Gipsy Six IIs.

SARO

NO civil types are at the moment in production at the Cowes (I.O.W.) works of the Saunders-Roe Company. In recent years they produced the Cutty Sark, Windhover and Cloud amphibian flying boats, all of which have been used for training, commercial or private operation. All these machines are cantilever monoplanes.

SCOTTISH

A BRITISH-BUILT version of the American Burnelli transport will soon be completed by the Scottish Aircraft and Engineering Co., Ltd. This type incorporates a fuselage of aerofoil section, the tail being carried on two booms, and is fitted with two 690 h.p. fully supercharged Rolls-Royce Kestrel XVIs. A disposable load of 5,680lb. will be carried, it is estimated, at a cruising speed of 216 m.p.h.

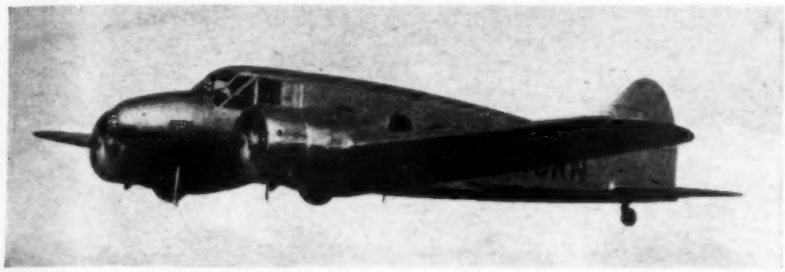
SHORT

THE most notable British commercial aeroplane completed during the past year is the Short Empire type of flying boat, twenty-eight of which have been ordered for the Empire routes of Imperial Airways. A very complete description of this type was given in *Flight* of October 29 this year, so it may suffice to recall that it is an all-metal, high-wing monoplane of 40,000lb. gross weight, fitted with four Bristol Pegasus XC engines driving D.H. variable pitch airscrews. By day, 24 passengers are accommodated in four cabins, and sleeping arrangements for 16 are included for night operation. There are two decks, the upper and lower, respectively housing the crew and freight and the passengers. The maximum speed is 200 m.p.h. at 5,500ft., and the main dimensions are: span 114ft., length 88ft., and height 31ft. 9¾in.

A somewhat similar machine will act as the lower component of the Short-Mayo composite aircraft, which consists essentially of a large flying boat carrying on its back, so to speak, a small heavily loaded seaplane which would otherwise be incapable of taking off safely. On reaching the operational height of the upper component the machines separate, the smaller seaplane then being capable of a 3,000-mile range with a load of mail. This composite machine is now under construction at the company's Rochester (Kent) works.

A further civil type is being offered as a landplane or on floats. This is the Scion Senior high-wing monoplane with four 90 h.p. Pobjoy Niagara IIIs. As a seaplane this machine cruises at 115 m.p.h. with up to ten passengers.

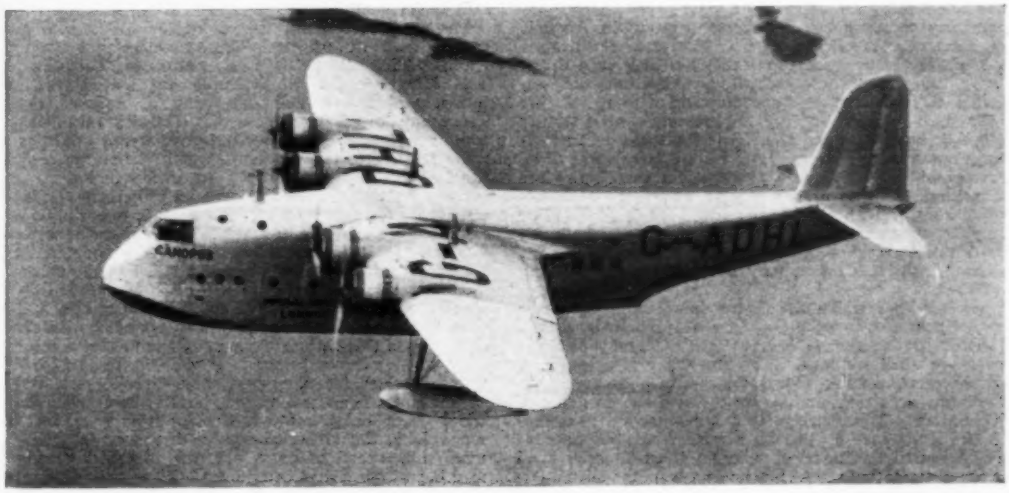
(Above)
With a pair of 90 h.p. Pobjoy Niagara IIIs the Pobjoy Scion cruises at 115 m.p.h. with a disposable load of 1,000 lb.



(Left)
This particular Avro 652 is one of two used by Imperial Airways. Later models incorporate certain improvements.

WEIR

AT a provisional price of £500, G. and J. Weir, Ltd., of Cathcart, Glasgow, S.4, Scotland, are offering a tiny Autogiro capable of direct take-off. The machine relies on similar



Capable of 200 m.p.h., the Short Empire type of flying boat is powered with four Bristol Pegasus XCs of about 800 h.p. each.

principles to those briefly described in the notes under the heading "Cierva" in this section. It is a single-seater and mounts one of the new Weir four-cylinder inverted air-cooled engines.

WICKO

A NAME not included in *Flight's* previous reviews of the British aircraft industry is that of the Foster, Wickner Aircraft Co., Ltd., of Lusty's Works, Colin Street, Bromley-by-Bow, London, E.3.

The company's first product is the Wicko monoplane, a £425 two-seater high-wing type with a converted Ford V.8 engine giving 85 h.p. at 3,500 r.p.m. A maximum speed of 115 m.p.h. is claimed, and the cruising and landing speeds are of the order of 100 m.p.h. and 50 m.p.h. respectively.

(Top) Shown here as a seaplane the Short Scion Senior (four Pobjoy Niagara III) is also available on wheels.

(Right) The Weir direct take-off Autogiro has the new Weir four-cylinder air-cooled engine.

(Below) The Tipsy cantilever monoplane (25 h.p. Sprite).

FOREIGN MACHINES on the BRITISH MARKET

Agencies in this Country

EARLY this year Surrey Flying Services, Ltd., who have been at the Airport of London as long as Croydon has been in existence, introduced to the European market the American Cessna C.34, a cantilever high-wing cabin monoplane. To date, three of these have been sold by S.F.S., and the fact that the machine carries four people, cruising at 143 m.p.h., for a consumption of just under 7½ gallons an hour is worth remembering; the price is £1,375.

This company took up the Beechcraft agency in August, and found that the C.17.R. model held the greatest interest. This 420 h.p. Wright-powered type cruises with 4 or 5 up at between 185 and 202 m.p.h., according to altitude, for 700 miles, and S.F.S. report the good consumption of 18-19 gal./hr.

With the idea of meeting the requirements of a wider clientele, S.F.S. have obtained the rights for three other well-known American types. The first and least expensive of these is the Porterfield 70, which is a two-tandem seat high-wing braced monoplane cruising at 105 m.p.h., and listed with full dual wheel brakes, tail wheel and trimming gear at £625. The cruising fuel consumption amounts to only 4.16 galls. an hour, and the 70 h.p. Le Blond engine has proved a dependable unit. This machine, with the Cessna, may be at Le Bourget during the Paris Salon.

The two other lines which S.F.S. are handling in 1937 are the Spartan Executive and the Sea Bird amphibian by Fleetwings. Both are in the *de luxe* categories, and deliveries cannot be made until January. The Executive is a low-wing all-metal monoplane seating 4 or 5 persons in a luxury cabin which is notable—in a single-motor type—for a silence figure of under 75 decibels. The fuselage is a semi-monocoque structure with the loads carried through a triangular steel boom—a practice also used in the wing, wherein the triangular steel girder forms a single spar. A Jacobs 285 h.p. model will be available, but it is anticipated that the standard power unit will be the 420 h.p. Wright; the respective cruising speeds at 5,000 feet are 168 and 208 m.p.h. The Sea Bird 4-seat amphibian was fully described in *Flight* of October 19 and will be remembered for its stainless steel shot-welded construction.

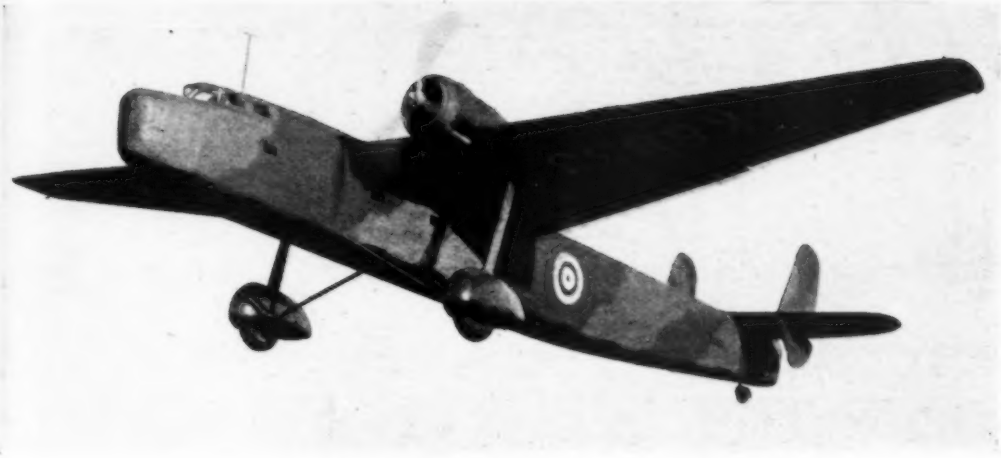
An interesting point is that, with the exception of the Porterfield, all the machines handled by S.F.S. are standardised with self-starting and lighting. Moreover, each falls into a category which has not as yet any real counterpart on this side of the Atlantic. It is understood that an interesting development is shortly forthcoming in connection with servicing.

The Stinson Reliant is now quite well known over here, where, with the Bi and Trimotor types, it is handled by Brian Allen Aiation, Ltd., also of Croydon Airport. The latest model is available in special and standard forms, and has a gull-type wing of unusual design with vacuum-operated slotted flaps. Interior arrangements of a comfortingly car-like type and easy flying qualities are the main features of the Reliant, which cruises at a speed little short of 140 m.p.h. for 400 miles on full tanks.

Not, perhaps, as well known as either the Reliant or the Trimotor, the Bimotor model B has a remarkably good performance, cruising at 162 m.p.h. for 720 miles with five passengers. It is a low-wing cantilever monoplane with two Lycoming engines—which are also fitted to the other Stinsons.

During this season the little American Taylor Cub has been seen about quite a lot at various flying meetings, and has been successful in a number of handicap air races. In the country of its origin this little cabin monoplane has been selling well.

Of all-metal construction, the Cub is fitted with a flat-four Continental engine of 37 h.p., and the pilot and passenger sit in tandem. The machine can, in fact, be flown solo (or otherwise) from either seat, and, since it is a braced high-wing monoplane, the view in essential directions is good. It has a maximum speed of 90 m.p.h. and a cruising range (at 75 m.p.h.) of 300 miles in still air. The price in this country is £498, and the sole distributor is Mr. A. J. Walker, of 23, St. Petersburg Place, London, W.2, or at Tollerton Aerodrome, Nottingham.



AN EXPANSION BOMBER

First Details of the Handley Page Harrow : Long Range Coupled with Large Military Load : Full Equipment of Defensive Armament : Slots and Flaps

ONE of the first heavy bombers designed and built under the R.A.F. expansion programme is the Handley Page Harrow, the prototype of which made its tests some time ago; the machine is now in full production at the Handley Page works at Cricklewood, as is also the previous model—a medium bomber.

It may, perhaps, be recollected that the medium bomber, the H.P.52, is a mid-wing cantilever monoplane, in which an unusual fuselage design provides maximum space for crew and bomb load, while giving a very clear field of fire for the gunners. The H.P.54, which is the makers' series number for the Harrow, is of totally different aerodynamic design, although certain structural features are shared by the two types.

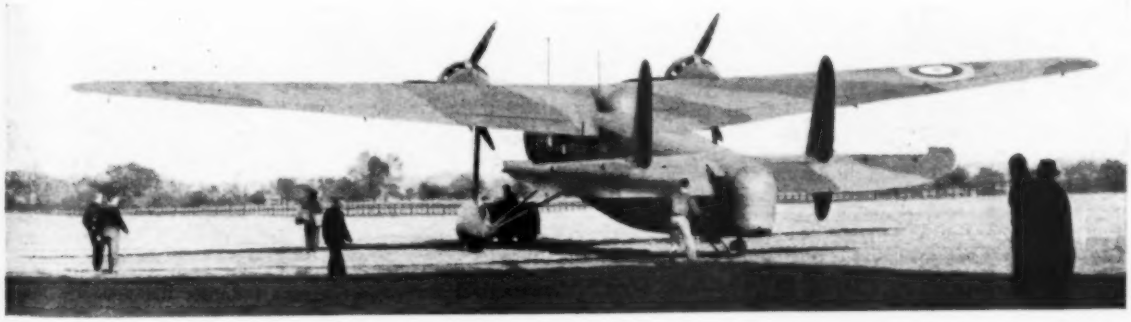
Doubtless, in order to afford a maximum of space for the crew and the very large bomb load carried, the Harrow was designed as a high-wing monoplane. This arrangement has numerous advantages from a service point of view, and the only disadvantage seems to be the difficulty, which amounts almost to an impossibility, of providing for a retractable undercarriage. In the H.P.54 the Palmer wheels are carried on very long telescopic struts from the wing, but as these struts are of streamline section they probably offer little drag. The same may be said of the two struts which brace the wheels to the lower corners of the fuselage, and, as the wheels are "spatted," the undercarriage drag is probably very small.

Of features in the aerodynamic design, attention may be drawn to the full use of slots and flaps. In addition to reducing the landing speed, these have the effect of improving the take-off and of steepening the gliding angle, thus making it possible to operate the machine from aerodromes of fairly modest size.

Two Bristol Pegasus engines are cantilevered out from the leading edge of the wing and enclosed in long-chord cowlings. The engine mountings are neatly faired into the wing surface so as to give a minimum of drag, and the engines drive De Havilland three-bladed controllable-pitch airscrews. In conjunction with a partial lowering of the trailing edge flaps, the controllable-pitch airscrews give a short take-off run.

The armament carried by the Harrow may not be described in detail, but the photographs show that the defensive armament includes three gun positions: one in the extreme nose, one in the extreme tail, and one above the fuselage near the trailing edge of the wing. It will be noticed that the stern-gunner's position is set so low in relation to the deck of the fuselage that the central gunner can fire above him. The use of twin rudders reduces the "blind area" of the two rear gunners almost to nothing.

Performance figures may not be published, but, in the matter of load carried over long ranges, the Harrow has exceeded the calculated figures.



The Handley Page Harrow. The lower picture gives a good idea of the large size of this new heavy bomber and shows the positions of the central and rear gunners. (*Flight* photographs.)

COMMERCIAL AVIATION

— AIRLINES — AIRPORTS —

THE WEEK AT CROYDON

Modern Romance : Surprises for 1937 : Air Conventions : New Work for First Officers : Mice and Marsupials

IN Kipling's poem dealing with the apparent decline of romance in our daily lives, epoch after epoch, we read that ". . . all unseen, romance brought up the nine fifteen." May be, but there's precious little romance about the average train, unless it be the new train-ferry where they manacle the train to the deck and hope people will sleep through the cross-Channel journey. There you have the old-fashioned "romance" from which air travel suffered ten or fifteen years ago, for I notice that this somewhat cumbrous method of crossing a stretch of water is very frequently cancelled when there is a spot of dirty weather. This, after all, is only an expensive elaboration of the "romantic" method of strapping a mail coach on to a railway truck and sitting triumphantly therein, in a top hat and whiskers.

What really *has* brought romance into modern life is the flying machine, and, if you want it all, go to the special charter pilot, such as Capt. C. W. H. Bebb, who flew Gen. Franco from the Canary Isles to Morocco just as the Spanish revolt broke out, and who also flew Don Juan March, the mystery millionaire behind the outbreak. Here was rich meat indeed, stealthy visits by soft-footed emissaries, signals, pass-words, disguises assumed in the air and uniforms cast overboard, half a playing card to be fitted to its other half before an emissary could be trusted, documents hurriedly got rid of before arrest and questioning by French Secret Service agents, and all the stuff, in fact, we characterise as rather far-fetched if we see a film or read a novel about it. Lots of equally exciting flights by charter pilots have remained unsung because no one is likely to talk about them.

Looking for Oneself

There's an amusing story—it happened last week—of two passengers who approached Capt. Horsey, in command of *Heracles*, inward bound from Paris, with the story of a twin-motor machine they had seen diving into the Channel. Horsey, as in duty bound, but *cum grano salis*, passed the information to Croydon, and necessary action was taken. Maybe those passengers saw an Air Dispatch machine, piloted by Capt. Garnons-Williams, and suddenly lost him behind a cloud. If so, you have the interesting situation of Garnons-Williams, who, of course, picked up the message, circling around while industriously looking for himself.

Owing to the temporary grounding of the D.H.86A for night work, Imperial Airways are putting *Scylla* on the 6.30 p.m. service from Croydon for Cologne. The machine will leave Cologne next day at 3 p.m., thus, of course, arriving here after dark.

Some people still think in terms of peg-top trousers and Dundreary whiskers. About the conferences being held everywhere to apportion major air routes, such as that over the North Atlantic, somebody wrote, "The Empire (of the air) is being carved this year in London, Washington, Paris and Berlin by groups of frock-coated gentlemen." Anyone proving that the head of any air combine habitually wears a frock-coat, is entitled to a free trip by air round the world.

It is not generally known that, even as early as this, most of the big companies have their next summer's timetables cut and dried. It's all very hush-hush, of course, but I might wager there will be some surprises next year, what with the Coronation, the Paris Exhibition, and one thing and another. Winter traffic continues to amaze everyone by its volume, and the same seems to apply to joy-riding.

First officers are kittle-cattle at time, according to one of the older captains. Things aboard an air liner have to be done in proper fashion, even down to small details. When asked to take over the controls recently, a newly-fledged first officer caused convulsions to a wireless officer and a fit of plate-bouncing for a steward, by responding, "Bai Jove, Rather," instead of with the more conventional "Aye, aye, sir." Quite a number of first officers, by the way, have been recalled from the East to do a turn of duty with the new Empire boats, for the navigators' exam. and for the interesting job of forming part of the delivery crews of the new boats as these are produced and handed over to Imperial Airways. One of the first people through Croydon to be a passenger aboard *Canopus* was Lieut.-Col. F. H. Herron, who was full of enthusiasm. Incidentally, he was aboard *Hengist*, which flew over Bagdad and which is said to have given the first news of the *coup d'etat*. The Governor of Nigeria was a privilege passenger recently on the Imperial Airways mail and freight service from Nigeria to Khartoum, on which line, by the way, tremendous precautions have to be taken against the spread of yellow fever, so that not even the Governor was immune from ordeal by Flit-gun on arrival.

The discovery of mice in a fuselage at Heston appears to have given some journalists bats in the belfry. Bigger air liners or huge flying boats may provide further problems, and some future antipodean flying boat, in for overhaul, may be accompanied by a chit directing the clearing out of all marsupials and aborigines, and for some definite action to be taken about the schools of shrimps in the bilge water, which, by perpetually swimming backwards tend to retard the forward movement of the boat.

A. VIATOR.

The Air France "Annual"

NO affair could be happier than the annual dinner which is given by Air France to its own staff, agency staffs and others. This year there were something like 400 people present at the Park Lane Hotel on November 6.

M. Louis Charvet, the general manager of the company, came over from Paris to preside and in acknowledging the toast of the Air France, proposed by Mr. E. Huskisson, manager of Thomas Cook and Son, he said that 70,000 passengers had been carried by his company during the past year. He said that 1937 would be an important year for many reasons and that the new 40-seaters would be in action on the London-Paris run in time for the Paris Exhibition and the Coronation.

Proposing the toast of the London office, Mr. Wallace Frame amusingly described the events during the first Air France "do" and spoke admiringly of the work of Mr. Jack Bamford and his staff. Mr Bamford replied and, later, Mr. James Mollison had some good words to say for the company's services.

Another Zone

WITH the official opening of the short-range radio station at Southampton on November 18 another controlled zone will come into force. This zone will be in an area enclosed by a circle of five miles' radius centred at Southampton airport. The station frequency will be 322 Kc/s (932 m.), the hours of service 0730 to 1830 daily, and the call-signs "GJD" and "Southampton."

In the Right Way

SINCE the firm's increase of capital and the addition to its board were announced in *Flight* a few months ago, Wrightways, Ltd., have been expanding steadily. The new offices, dope shop, radio and general repair shops, and so on, are nearly ready in the larger hangar which they have taken over at Croydon, and a D.H. 86A and 89 have been acquired.

The former is fitted with ultra-short-wave receiving equipment and, now that both Croydon and Le Bourget, in addition to Heston and a very large number of Continental airports, have beam transmitters, it should be possible to fly with something fractionally approaching 100 per cent. reliability on newspaper and other services. Both the 86A and the 89 are luxuriously equipped for passenger work.

Back in the Constructional Fold

IT has been known for some time that Flt. Lt. N. Comper has been engaged on the design of certain new types.

The activities of his company have now been extended to embrace the development of these designs and their production, in addition to the normal functions of the company in an aeronautical advisory capacity. Concurrently changes are being made in the directorate and in the name of the company.

Whilst actual figures are not yet available for publication, the first of the new series of Comper aircraft, which has been named the "Commerce" has now reached the detailed design stage. Its name, suggests that it is being produced primarily to meet the requirements of the aircraft operator.

In addition, a design in an entirely different class is well advanced.

IMPERIAL FACTS—AND FUTURE

Extracts from the Chairman's Speech at the Twelfth Annual Meeting of Imperial Airways

IN the absence of Sir Eric Geddes, who was under doctor's orders, Sir J. George Beharrell read the chairman's speech at the Imperial Airways meeting last Tuesday, November 10. Here are quoted a few of the more important points mentioned:—

"During the year under review the total traffic carried on all services was more than double that carried in the year 1932-33; that is, over 100 per cent. increase in three years.

"On the Empire routes as a whole we flew over 90 per cent. more miles than the minimum necessary to earn our subsidy. On the same services we carried 170 tons of mail more than the previous year, and our passenger traffic increased by over 26 per cent. . . . The average distance flown per passenger on our Empire services was 2,025 miles. . . .

"Notwithstanding the greatly increased competition with which the company is faced on the European routes, it is satisfactory to note that we carried over 11 per cent. more passengers than the previous year. . . .

"We have, as you know, for some time past exceeded by far the mileage which we are obliged to fly on the European services to earn our subsidy, and during the year under review we flew over 4¾ times the amount of mileage necessary. . . .

"The year which we are now reviewing was the first complete year in which the England-India service was operated at a frequency of twice weekly throughout. . . . The effect of this was to increase the capacity over this section by 55 per cent. over the previous year. Notwithstanding this increase we sold almost 61 per cent. of the capacity offered as compared with 50 per cent. the previous year. All classes of traffic contributed to this improvement, but principally air mails, which increased by almost 130 per cent. over the previous year.

"On the South African section the results have exceeded our expectations. We sold over 73 per cent. of the capacity operated on this line. . . .

"During the year our company and our subsidiary and associated companies flew a total of over 6,500,000 miles. During the current year this figure will probably reach 8,000,000 miles, so that the family is now flying an average of over 20,000 miles a day. The company and its subsidiaries—but excluding associated companies—carried over 68,000 passengers and nearly 1,250 tons of mail, freight and excess baggage.

"In 1924-25, the first year of the company's life, we had 1,760 miles of airway in operation. . . . To-day Imperial Airways and its subsidiary and associated companies have over 27,000 miles of airway in regular operation. . . .

"After careful investigation and in consultation with the Air Ministry we came to the conclusion that Langstone Harbour at Portsmouth held the balance of advantages over the other sites considered. . . . In the meantime we have been obliged to make arrangements to use Southampton Water for the commencement of our Empire flying-boat services. . . .

"I informed you last year that we had outgrown our accommodation at Victoria and that we were negotiating for a suitable site on which we hoped to erect a building specially designed to handle our business. A serious hitch, however, has occurred with the Grosvenor Estate Trustees. . . .

"A new operating company is to be formed at the instance of three companies, viz.: Imperial Airways, as the chosen instrument for the United Kingdom Government, a company to be nominated by the Canadian Government and a company to be nominated by the Irish Free State Government. Of the capital of this company, 51 per cent. is to be subscribed by our company and three of the nine directors are to be nominated by us—including the chairman and managing director. The remainder of the capital of the company is to be held as to 24½ per cent. by the Canadian company and 24½ per cent. by the Irish Free State company, each of whom will also nominate three directors to the Board. . .

"For the purpose of carrying out the developments which I have outlined to you and particularly the Empire mail scheme and the Atlantic services, we shall, before our next annual general meeting, have to issue fresh capital, but we are unable to proceed with this matter until the *ipsissima verba* of our new agreement with the Government—which will be for fifteen years—have been finally agreed and the agreement itself has been signed."

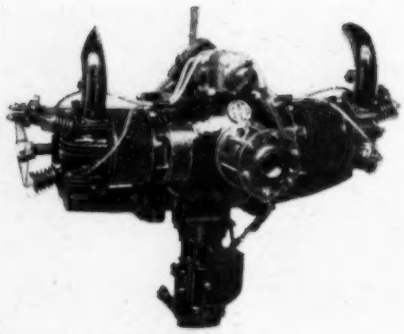
POWER BOATS

Latest Productions of the British Power Boat Company to Service Imperial Airways Empire Routes

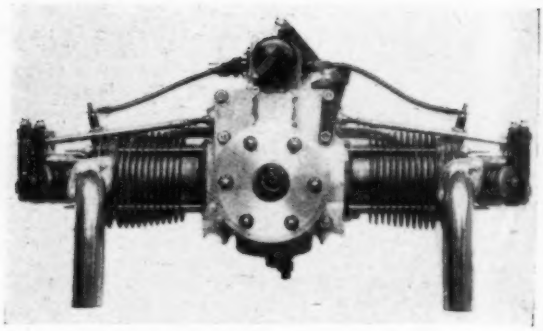
IT was announced in last week's issue that thirty seaplane control launches had been ordered from the British Power Boat Co., of Hythe, Southampton, by Imperial Airways in connection with Empire air route development. The duties of these boats are summarised by the phrase "General tending of seaplanes." The construction was carried out with a view to withstanding the rigorous tropical climates to which these craft may be submitted, and simplicity to allow major repairs to be carried out to the hull. An unusual degree of seaworthiness allows the undertaking of long-distance non-stop sea journeys. The controllability is high; it is possible to turn completely round in one length.

A crew of two only is needed, the two 100 h.p. "Power" Meadows engines being simple in operation and giving instantaneous starting from cold and easy access to all parts for inspection and adjustment. There are many hundreds of these engines in the service of the Royal Air Force and Navy. The equipment includes an electric generating system supplying energy and light for two-way radio and the high-powered searchlight. Upholstered seats for twenty passengers in the main cabin contain B.O.T. pattern life jackets for all.

Power Boats have undergone a long period of development in R.A.F. and Royal Navy, and a number have for some time been in service with Imperial Airways.



This compact A.B.C. Mk. II Scorpion has a maximum output of 40 b.h.p.



The Aero Engines, Ltd., Sprite is of 803 c.c. capacity. Its key-note is simplicity.

BRITISH AERO E

Higher Power Ratin and

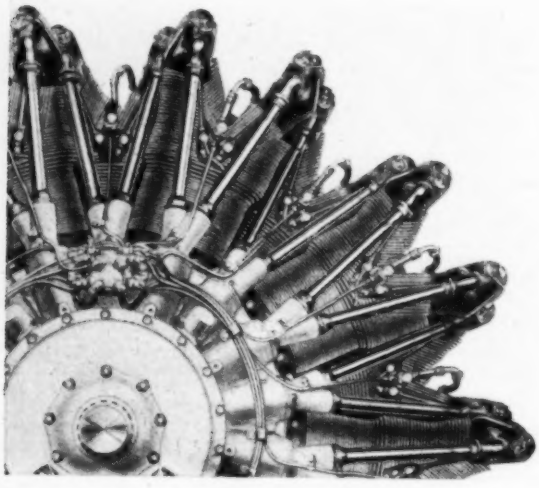
DEVELOPMENT of British aero engines has during this year proceeded in every direction in an unprecedented manner. Several new names appear in the long list of manufacturers, and a diversity of new types has been introduced. In the light of new knowledge and experience with leaded fuels and V.P. airscrews, well-proved existing types have been modified and developed to give new power ratings much in advance of previous standards. There has been a tendency this year towards higher-powered military types, but at the other extreme great strides have been made in the ultra-light field. In a very short time the many civil supercharged engines reported at present on the drawing-boards or in embryo will be in production.

A.B.C.

AS far back as 1911, A.B.C. Motors, Ltd., of Walton-on-Thames, Surrey, first produced engines, of six and vee-eight type, and during the War the seven and fourteen-cylinder Wasp and Dragonfly. In 1924 the first Scorpion flat-twin completed tests, giving 30 b.h.p. at 3,100 r.p.m. From that time the Scorpion has been developed and modified as the type became popular for modern light aircraft.

The outcome, the Scorpion Mark II, is an air-cooled, horizontally-opposed twin with steel cylinders and cast-iron heads, each of which carries two push-rod-operated valves. The induction manifold and crankcase are cast as a unit, thus at once heating mixture and cooling oil.

The normal power output is 34 b.h.p. at 2,300 r.p.m. with a maximum output of 40 b.h.p. The dry weight of the engine is 109 lb.



The design of the 18-cylinder Alvis Alcides and Alcides Major is based on the Gnome Rhone L.18.

AERO ENGINES

THIS year two new engines are offered by Aero Engines, Ltd., of Kingswood Works, Bristol, the "Sprite" and "1½-litre," both being horizontally-opposed twins. The Sprite is of 803 c.c. capacity. The cast-iron heads, each carrying two valves operated by push-rods from the one-piece camshaft, have machined spherical combustion chambers and are fitted for 14 mm. plugs. The connecting rods are fully machined stampings, hardened at the big ends to carry floating bushes on the two-throw crankshaft running on a single ball, and double ball and thrust races at back and front ends respectively. The small ends are fitted with floating bushes on the gudgeon pins, the latter being located sideways in the heat-treated "Y" alloy pistons by spring circlips. B.T.H. magneto, Zenith carburetter and A.C. fuel pump are used. The Sprite is rated at 22.7 b.h.p. with 24.3 maximum b.h.p. at 3,150 r.p.m.

Information regarding the 1½-litre engine is still limited. It is a left-hand tractor unit with alternative methods of mounting. It fulfils Air Ministry conditions in having twin magnetos, and the weight ungeared, including these latter, the airscrew hub and petrol pump, is given as 110 lb. The maximum power is 42-45 b.h.p. at 3,500 r.p.m.

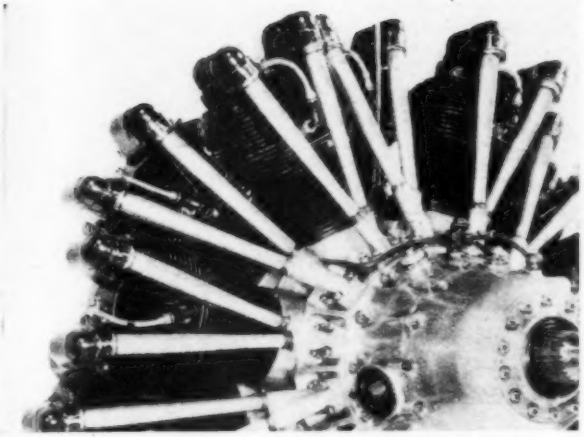
ALVIS

MANUFACTURE of two engines has commenced at the Coventry aero engine works of Alvis, Limited, each being available in fully supercharged (known as the "Major") or moderately supercharged form, and also in direct drive or geared versions. The design of both the 1,300 h.p. Alcides and the 1,000 h.p. Pelides is based on that of the Gnome Rhone, but with certain modifications. The equipment is very complete and compact; it includes, besides dual ignition and screening, dual petrol and oil pumps, hand and electric starter, generator, compressor, gun gear, tachometer and spare drives.

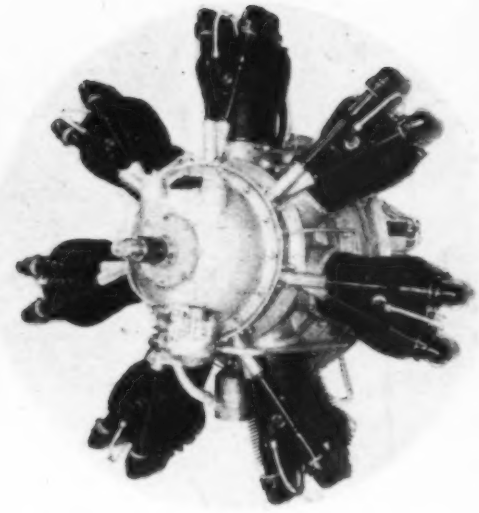
ARMSTRONG SIDDELEY

THE very comprehensive Armstrong Siddeley range is this year further augmented by engines fitted with variable pitch airscrew equipment. These are the Cheetah IX with Ratier constant speed and Tiger IX with D.H. variable-pitch aircrews. These, together with the 160 b.h.p. Genet Major IV and the 340 h.p. Serval V are the latest additions.

The Serval, Jaguar and Lynx have many interchangeable parts. All are of the air-cooled radial type, with seven, ten or fourteen cylinders. Special attention has been paid to the



The fourteen-cylinder, two-row Armstrong Siddeley Tiger IX gives, with a De Havilland V.P. airscrew, 880 b.h.p. for take-off.



The seven-cylinder Cheetah IX has a very clean frontal aspect and can be adapted to use a Ratier V.P. airscrew.

ENGINES

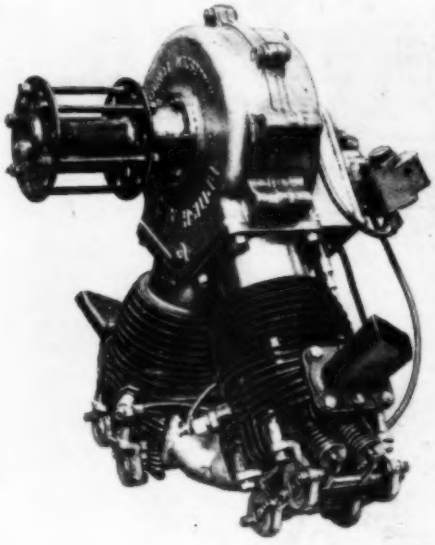
and Many New Types

finning of the heads, with both higher compression ratios (permissible through the use of 87-octane fuel) and deep-chord cowlings in mind.

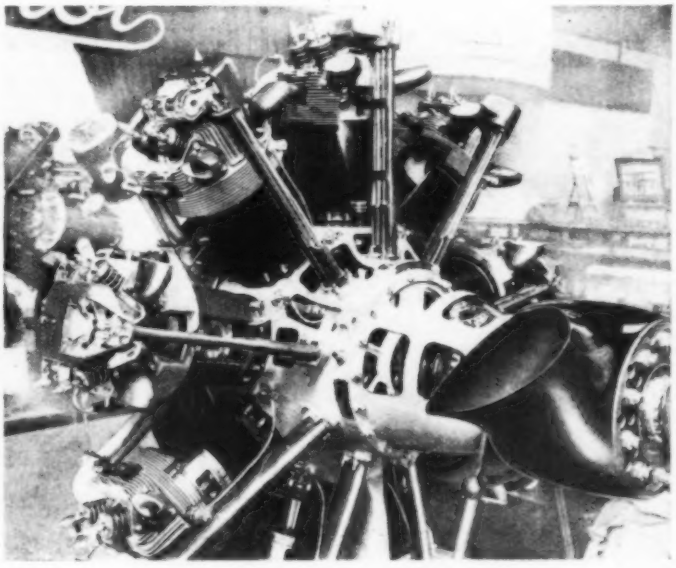
Each steel cylinder barrel is screwed, shrunk and locked to a light alloy head carrying valves operated by totally enclosed rockers and push-rods from a cam drum which runs at one-eighth crankshaft speed. The cam drum varies in number of tracks and drive according to the engine; in the Tigers, Panthers and Genet Majors, epicyclic drives are used, while the Cheetahs have a drive from a fixed timing gear on the crankshaft. The Lynx has a train of back gears.

The one-piece high-tensile steel crankshafts are carried on roller bearings at front and rear and the master rod is always in the vertical cylinder. The pistons are of "Y" alloy or, for the Tiger, of Hiduminium forgings, and carry in general two compression and one scraper ring above the floating gudgeon pin and one single or double scraper below. Split big-ends are used on the master rods and in the Tiger and Panther the bearings are of lead-bronze; in the smaller types white metal is used. On the Tiger the auxiliary rods have fixed bronze bushes on both gudgeon and wrist pins but the Panther has floating wrist pins located in flanges on the two master rods, which carry and are carried in bronze bushes.

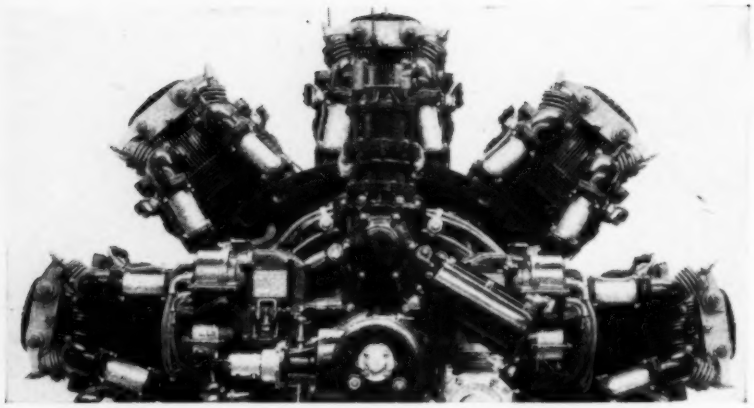
The crankcases are aluminium alloy castings, except in the



The direct-drive version of the sturdy-looking vee-twin British Anzani has a maximum output of 34 b.h.p.



A sectioned example of the familar Pegasus range



(Left)
The Bristol Mercury VIII gives 850 b.h.p. maximum at 14,000 ft.

(Below) The clean-cut outline of the sleeve valve Perseus can be appreciated in this photograph.

case of the Tiger and Genet, where they are forgings machined all over. When fitted, the reduction gear is of epicyclic type housed in the front casing, together with oil pump, relief valve, filter and timing gears. The rear crankshaft gear drives intermediate and auxiliary idler gears carried on the rear diaphragm plate; the induction casing, cast integral with the bearer flange, contains the fan, geared or running at engine speed, which delivers the mixture to normally aspirated or supercharged engines respectively.

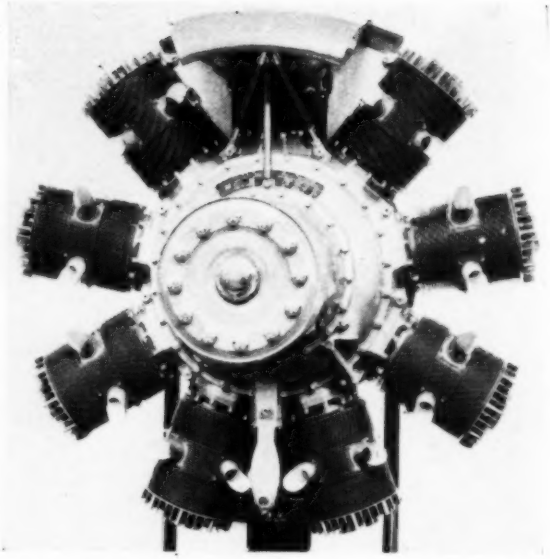
The rear cover, to which is fitted carburetter and heater box, carries hand, electric or gas starter, petrol pumps, gun gear, spare and tachometer drives; Claudel Hobson carburetters and B.T.H. magnetos are fitted.

All performance figures for current models are given in the table on page 504. Armstrong Siddeley Motors, Ltd., of Coventry, are the makers.

BRISTOL

FEW firms are engaged in such intensive development and improvement as the Bristol Aircraft Co., Ltd., at their works at Filton, Bristol. Two poppet-valve and two sleeve-valve radial engines are available. Of type, the former Pegasus and Mercury are offered moderately supercharged as the Pegasus X, XC, Xi, XII (the difference being in reduction gear ratio and, for the civil X, lower rating), or fully supercharged as the Mercury VIII and IX and the Pegasus XX. All types are approved for D.H. V.P. airscrews.

The crankcase is a hiduminium forging split at the cylinder centre line, the nine joining bolts also holding the supercharger and volute casing. The cylinders are alloy steel forgings with "Y" alloy heads carrying four valves apiece, operated through totally enclosed rockers and push-rods bearing on a

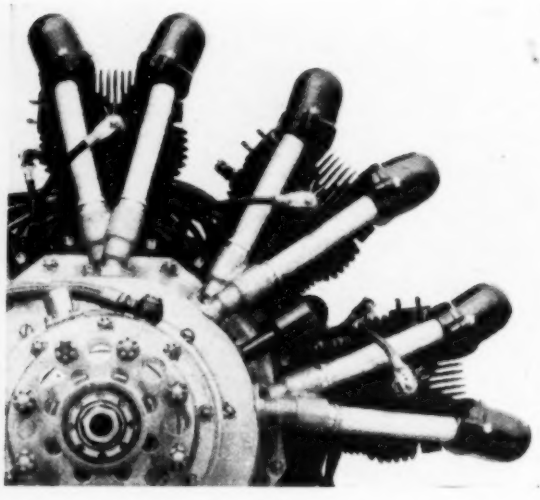


cam sleeve located between epicyclic bevel reduction gear and crank throw.

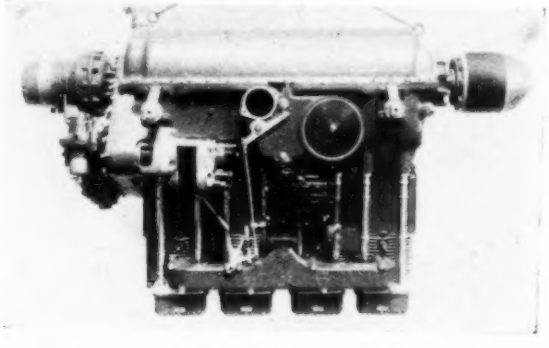
The principle of the Bristol tappet clearance compensation device is that the rocker box pivots about two pillars, the front of the box being linked by a tie bar through the push-rod casing to the crank case.

The valves and valve seats are now stellited and the sodium-filled exhaust valves have hardened buttons on the stems end.

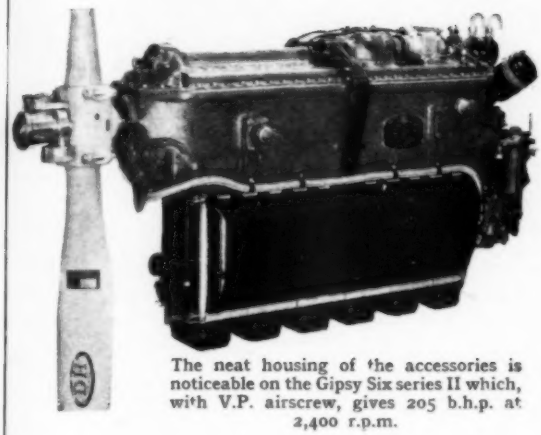
Forged pistons carry two compression and one scraper ring above the gudgeon pin and one scraper below. The master



The A.D. 9.R series III British Salmson gives 80 b.h.p. at 3,000 r.p.m.

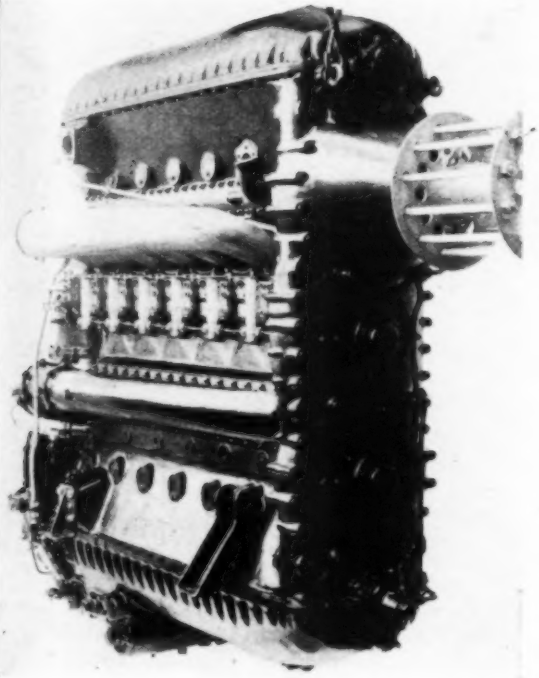


There should be no difficulty in streamlining the 135/148 b.h.p. Cirrus Major Mk. II.



The neat housing of the accessories is noticeable on the Gipsy Six series II which, with V.P. airscrew, gives 205 b.h.p. at 2,400 r.p.m.

This little 1,860 c.c. J.A.P. has a separate finned oil compartment below the crankcase.



rod is in No. 6 cylinder and has a one-piece big end with flanges for the pressure-lubricated wrist-pins. It is carried on a large-diameter crank-pin, the bearing being a floating steel bush, both sides of which are lined with a newly developed bearing metal. The split 70-ton nickel-chrome-steel crankshaft is carried on single ball and double roller races. The crank-pin and rear half are joined by a manéton bolt—a proved Bristol practice.

The Bristol air-cooled sleeve-valve engines, the Aquila and the Perseus, are the first of the type to go into series production. The simple design made possible by the complete absence of external valve gear allows quiet operation, simpler cooling and cowling and freedom from oil leaks. It reduces servicing and adjustment and adds to reliability, while cooler exhaust temperatures and greater fuel efficiency are permitted.

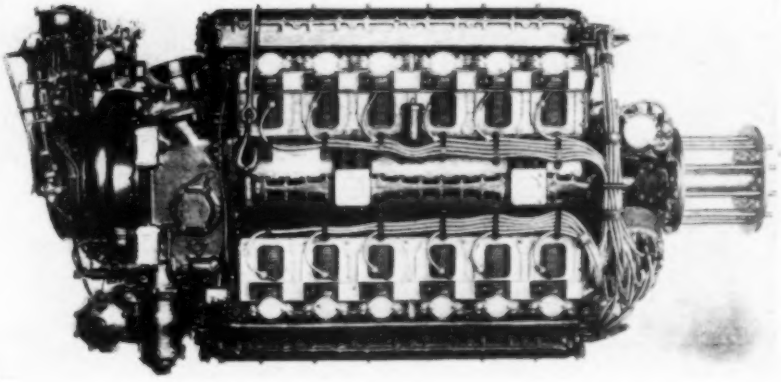
For 795 lb. weight the civil-rated Aquila gives 500 b.h.p. at 2,600 r.p.m., the maximum power at sea level. It is calculated that 287 b.h.p. should be available at 10,000 ft. and 2,400 r.p.m. The suitable Bristol cowling unit with exhaust ring and inter-cylinder baffles weighs 120 lb. The civil-rated Perseus II of 24.8 litres capacity, as compared with 15.6 litres of the Aquila, gives a maximum output of 740-770 b.h.p. at 2,525 r.p.m. for a weight of 1,026 lb. The Perseus VIII has a maximum of 810 b.h.p. at 5,250 ft. and 2,525 r.p.m.

BRITISH ANZANI

THE small inverted vee-twin 26-34 b.h.p. engine produced by the British Anzani Engineering Co., Ltd., Kingston-on-Thames, Surrey, is only one side of the firm's interest in aero engines, as a steadily increasing amount of sub-contract work is being undertaken for the Air Ministry. The Anzani engine is of 1,100 c.c. capacity, and the close-grained-iron, air-cooled cylinders are set at 57 deg. on the die-cast aluminium crank case and have four-valve heads. The double-arm, push-rod-operated rockers have grease-cupped ball bearings. A reduction gear is optional with the engine.

(Above) The Napier Culverin twelve-piston compression-ignition engine is of unusual appearance.

(Right) Concentrated power is the impression given by this 24-cylinder Napier Dagger III.



British Aero Engine Data

Maker and Type.	No. and Arrangement of Cyls.	Cooling.	Bore.	Stroke.	Compression Ratio.	Reduction Gear Ratio.	Normal Crankshaft R.P.M.	Rated Altitude.	Normal Output at Rated Altitude.	Max. Output at Full Throttle Height.	Take-off Power.	Dry Weight.	Remarks.
			m.m.	m.m.				ft.	B.H.P.	B.H.P.	B.H.P.	lb.	
A.B.C.:													
Scorpion Mk II	2H.O.	A.	102	91.44	6	D.	2,300	S.L.	34	40	40	100	Ultra-light type.
AERO ENGINES:													
Sprite (803 c.c.)	2 H.O.	A.	79	82	6	D.	2,850	S.L.	22.7	24.3	24.3	77.25	Ultra-light-type.
1½-Litre	2 H.O.	A.	100	100	5.7	D.	2,800	S.L.	38/40	42/45	42/45	110	Ultra-light type.
ALVIS:													
Pelides	14 R.	A.	146	165	5.5	D.	2,400	5,000	1,000	1,105	1,030	1,190	Moderately supercharged.
Pelides Major	14 R.	A.	146	165	5.5	0.5	2,400	12,000	1,000	1,090	930	1,190	Supercharged.
Alcides	18 R.	A.	146	180	5.5	or	2,150	5,000	1,300	1,470	1,400	1,570	Moderately supercharged.
Alcides Major	18 R.	A.	146	180	5.5	0.684	2,150	13,000	1,225	1,345	1,120	1,570	Supercharged.
ARMSTRONG SIDDELEY:													
Genet Major Ia	7 R.	A.	114.4	114.4	5	D.	2,300	S.L.	150	165	150	327	—
Genet Major IV	7 R.	A.	114.4	114.4	5	0.663	2,400	S.L.	160	180	160	367	—
Lynx IV C	7 R.	A.	127	139.9	5	D.	1,900	S.L.	215	240	215	515	—
Cheetah V	7 R.	A.	133.3	139.7	5.2	D.	2,100	S.L.	275	305	275	566	—
Cheetah IX	7 R.	A.	133.3	139.7	6.35	D.	2,100	6,000	310	350	338	635	Moderately supercharged.
Cheetah IX (V.P.)	7 R.	A.	133.3	139.7	6.35	D.	2,100	6,750	335	345	368	635	Max. power at 7,300ft. for IX. & 7,800ft. IX.(V.P.)
Serval V	19 R.	A.	127	139.7	5	D.	2,000	6,500	340	381	370	730	Moderately supercharged. Max. power at 7700ft.
Jaguar VI C	14 R.	A.	127	139.7	5	0.657	2,000	S.L.	460	490	460	910	—
Panther VII	14 R.	A.	133.3	139.7	5.2	0.657	2,100	12,000	560	604	590	1,045	Supercharged. Max. power at 13,750ft.
Panther X	14 R.	A.	133.3	139.7	5.2	0.657	2,250	3,000	700	752	735	1,068	Moderately supercharged. Max. power at 4,800ft.
Tiger III A	14 R.	A.	139.7	152.4	5.35	0.657	2,050	12,000	610	656	625	1,159	—
Tiger IX (V.P.)	14 R.	A.	139.7	152.4	5.35	0.594	2,375	6,250	795	805	880	1,248	Moderately supercharged. Max. power at 7,200ft.
BRITISH ANZANI:													
1,100 c.c.	2 I.V.	A.	83	101.5	—	D.	2,500	S.L.	26	34	34	99	Geared version available.
BRISTOL:													
Mercury VIII	9 R.	A.	146	165	—	0.572	2,400	13,000	840	730	700/730	980	Supercharged. Max. power at 14,000ft.
Mercury IX						0.50							
Mercury	9 R.	A.	146	165	—	0.572	2,400	3,500	750/780	835	780	980	Moderately supercharged. Max. power at 6,500ft.
Pegasus XC	9 R.	A.	146	190.5	—	0.50	2,250	4,500	785/815	830	920	1,015	Moderately supercharged. Max. power at 5,250ft.
Pegasus X	9 R.	A.	146	190.5	—	0.50	2,250	4,000	810/850	915	900	1,005	Moderately supercharged. Max. power at 6,250ft.
Pegasus XI						0.572							
Pegasus XIX	9 R.	A.	146	190.5	—	0.571	2,250	8,500	800/835	925	835	1,015	Supercharged. Max. power at 10,000ft.
Pegasus XX						0.50							
Civil-rated Aquila	9 R.	A.	—	—	—	—	2,250	S.L.	420	500	420	795	—
Civil-rated Perseus II	9 R.	A.	—	—	—	—	2,200	S.L.	649/665	740/770	640/665	1,026	—
Perseus VIII	9 R.	A.	—	—	—	—	2,200	5,000	670	810	700	1,040	Max. power at 5,250 ft.
BRITISH SALMSON:													
A.D.9	9 R.	A.	70	86	6	D.	2,100	S.L.	48	54	54	160	—
A.D.9.R Series III	9 R.	A.	73	86	6	0.5	3,000	S.L.	80	86	86	188	—
CARDEN:													
1,172 c.c.	4 L.	W.	63.5	92.46	6.6	D.	3,300	S.L.	30	32	32	130	Ultra-light type.
CIRRUS-HERMES:													
Minor	4 I.L.	A.	95	127	5.8	D.	2,300	S.L.	82	90	90	195	—
Major Mk. II	4 I.L.	A.	—	—	—	D.	2,600	S.L.	135	148	148	—	—
COVENTRY VICTOR:													
1½-litre	4 H.O.	A	78	78	6.7	D.	2,500	S.L.	25	30	30	130	Ultra-light type.
1,600 c.c.	4 H.O.	A.	80	80	6.7	D.	2,500	S.L.	28	35	35	130	Ultra-light type.
DE HAVILLAND:													
Gipsy Major	4 I.L.	A.	118	140	5.25	D.	2,100	S.L.	120	120	130	300	—
Gipsy Six Series I	6 I.L.	A.	118	140	5.25	D.	2,100	S.L.	185	200	200	468	—
Gipsy Six Series II	6 I.L.	A.	—	—	6	D.	2,100	S.L.	185	205	—	469	V.P. Airscrew optional.
J.A.P.:													
1 860 c.c.	2 H.O.	A.	108	101.6	5.2	D.	2,400	S.L.	38	—	—	115	Engine built under Aeronca licence.
NAPIER:													
Rapier V	16 H.	A.	89	89	7	0.390	3,500	10,000	305/315	330/340	325/335	720	Supercharged. Max. power at 13,000ft.
Rapier VI	16 H.	A.	89	89	7	0.390	3,500	4,000	345/360	380/395	350/365	713	Moderately supercharged. Max. power at 5,800 ft.
Dagger II	24 H.	A.	97	95	7.75	0.372	3,500	10,000	670/695	725/755	630	1,305	Supercharged. Max. power at 12,500 ft.
Dagger III	24 H.	A.	97	95	7.75	0.372	3,500	3,500	700/725	780/805	755	1,305	Moderately supercharged. Max. power at 5,000ft.
Culverin	6 L.	W.	120.7	200.7	—	0.693	1,700	S.L.	720	—	—	1,785	C.I. Engine built under Junkers licence.
PHILLIPS AND POWIS:													
Pirate C4	4 I.L.	A	120.5	130.2	5.8	D.	2,175	S.L.	125	—	—	290	Engines to be built under Menasco licence.
Pirate C4S	4 I.L.	A.	120.5	130.2	5.8	D.	2,200	3,000	150	200	—	305	Moderately supercharged.
Buccaneer B6	6 I.L.	A.	114	130	5.5	D.	1,975	S.L.	160	—	—	385	—
Buccaneer B6S	6 I.L.	A.	114	130	5.5	D.	2,250	4,500	200	270	—	415	Moderately supercharged.
POBJOY:													
Niagara III	7 R.	A.	77	87	6	0.468	3,300	S.L.	88	95	95	156	—
Cataract III	7 R	A.	77	87	5.8	0.468	3,300	S.L.	—	88	—	156	De-rated Niagara III.
ROLLS-ROYCE:													
Kestrel IV						0.632							
Kestrel V	12 V.	W.	127	140	6	0.553	2,500	11,000	600	640	700	955	Supercharged. Max. power at 14,000 ft.
Kestrel VI						0.477							
Kestrel VII						0.632							
Kestrel VIII	12 V.	W.	127	140	6	0.553	2,500	3,000	675	730	700	955	Moderately supercharged. Max. power at 5,000ft.
Kestrel IX						0.477							
Kestrel X						0.632							
Kestrel XI	12 V.	W.	127	140	7	0.553	2,500	S.L.	570	625	550	900	—
Kestrel XII						0.477							
Kestrel XVI	12 V.	W.	127	140	6	0.477	2,600	11,000	630	745	670	955	Supercharged. Max. power power at 14,500 ft. V.P. Airscrew optional.
Merlin	12 V.	W.	137.2	152.5	6	0.477	—	—	—	—	—	—	Figures not released.

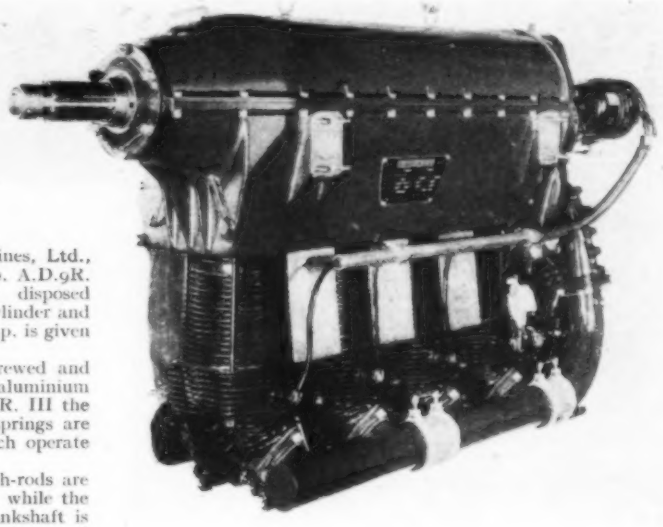
A. = Air. W. = Water. D. = Direct Drive. R. = Radial. I. = Inverted. H. = "H" Formation. V. = "V" Formation. L. = In Line. S.L. = Sea Level.

Concluded on page 505.

BRITISH AERO ENGINE DATA (*Contd.*)

Maker and Type.	No. and Arrangement of Cyls.	Cooling.	Bore.	Stroke.	Compression Ratio.	Reduction Gear Ratio.	Normal Crankshaft R.P.M.	Rated Altitude.	Normal Output at Rated Altitude.	Max. Output at Full Throttle Height.	Take-off Power.	Dry Weight.	Remarks.
			m.m.	m.m.				ft.	B.H.P.	B.H.P.	B.H.P.	lb.	
SCOTT: Flying Squirrel	2 I.L.	A.	73	78	6.8	0.50	3,200	S.L.	16	28	28	85	—
VILLIERS HAY: Maya	4 I.L.	A.	—	—	—	D.	2,300	S.L.	120	130	130	275	—
WEIR: 2,000 c.c.	4 I.L.	A.	80	100	—	D.	2,300	S.L.	45	50	50	112	—
WOLSELEY: Aquarius Mk. I	7 R.	A	106	120	5.35	D.	2,250	S.L.	155	170	170	375	—
Scorpio Mk. I	9 R.	A.	111	120	5.25	0.629	2,250	S.L.	230	250	250	536	—
Scorpio Mk. II	9 R.	A.	111	120	6.5	0.629	2,250	16,000	260	295	277	530	Moderately supercharged.

A. = Air. W. = Water. D. = Direct Drive. R. = Radial. I. = Inverted. H. = "H" Formation. V. = "V" Formation. L. = In Line. S.L. = Sea Level.



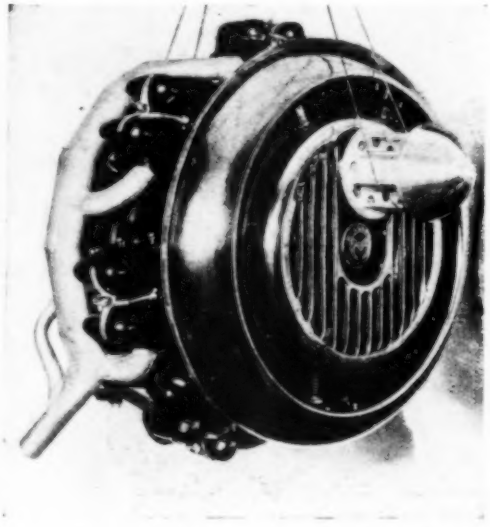
(Right) The long, inter-cooling induction pipe from the supercharger is clearly shown on the Menasco 150/200 b.h.p. Pirate C.4.S. soon to be built under licence by Phillips and Powis.

BRITISH SALMSON

THE latest product of British Salmson Aero Engines, Ltd., of Raynes Park, London, S.W.20, is the 80 h.p. A.D.9R. Series III. A small engine with nine radially disposed cylinders means smooth running, low capacity per cylinder and therefore simpler air cooling. A maximum of 86 b.h.p. is given at 3,310 r.p.m.

Heat-treated steel forgings, the cylinders are screwed and shrunk into the two-valve alloy heads, which carry aluminium oil bath valve and rocker enclosure. On the A.D.9R. III the valve stem tips are stellited, and two coil valve springs are fitted to each. Adjustment is on the rockers, which operate on needle bearings.

On the smaller engine, the A.D.9, adjustable push-rods are fitted and the rockers run on plain bronze bearings, while the valve springs are of the "hairpin" type. The crankshaft is built up and the solid big end of the "H" section master rod has a white metal bearing. The eight articulated rods are of tubular section and have phosphor-bronze bushes. The dual magnetos run at 9:8 engine speed and the 0.5:1 reduction gear is of the concentric bevel type.



The cowling is supplied as an integral part of the 88/95 h.p. geared Pobjoy radial Niagara III.

CARDEN

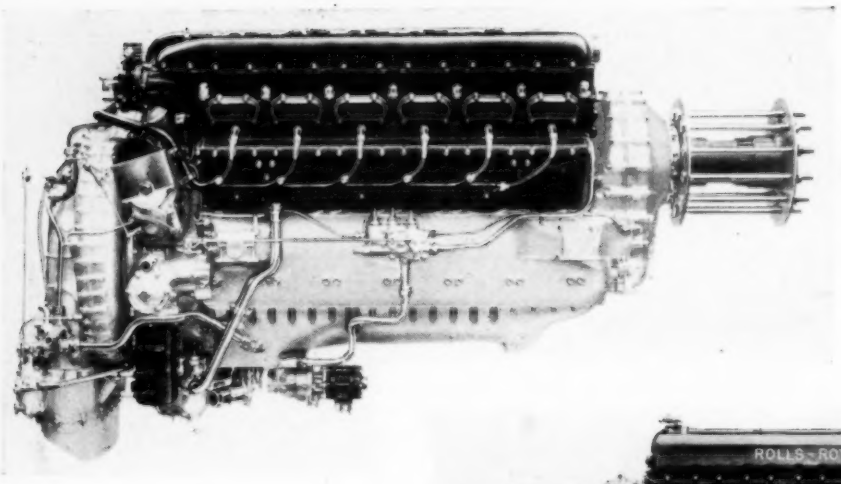
CARDEN AERO ENGINES, LTD., of Heston Airport, Middlesex, have further developed the 10 h.p. Ford car engine for aero work. The unit construction engine has a special aluminium alloy head with water header tank. The alloy pistons, of the split skirt type, each carry two compression rings and one scraper, and have splash-lubricated bronze little-end bearings on the "I" connecting rods. Babbit metal big-end bearings and three-bearing crankshafts are fitted. Each cylinder has two valves with hollow tappets, and is fitted for two sparking plugs.

Equipment includes one or two B.T.H. magnetos and Zenith updraught carburetter. The use of standard car parts makes the initial price and the price of spares very low; and the other advantages of frontal area, easier streamlining, more efficient cooling at low speeds (e.g., in climbing, taxying and use in pusher form) easily balance the disadvantages of added weight. The maximum power at 3,500 r.p.m. is 33 b.h.p.; the price is £55.

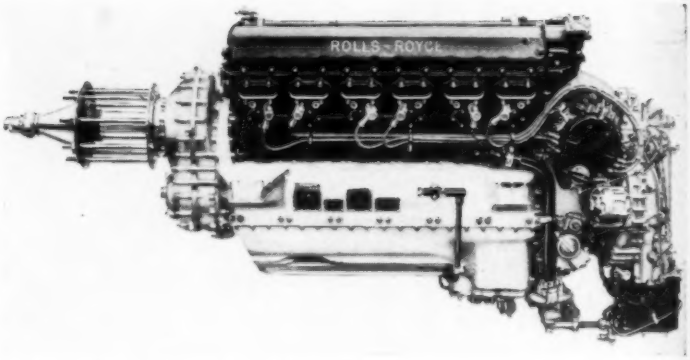
CIRRUS

CIRRUS-HERMES ENGINEERING CO., LTD., of Brough, Yorks, offer two well-established inverted, in line "fours," the 135-148 b.h.p. Major Mark II and the 80-90 b.h.p. Minor. The clean lines and low frontal area of these engines are noticeable. The cylinder heads of the Mark II Major, with ports well separated for cooling, are attached to the barrels by studs, with a copper jointing washer, and each cylinder has four bolts to the crank case. The Hiduminium connecting rods have white-metal big ends. The rear timing cover carries a double Amal fuel pump, B.T.H. starter and generator with tachometer drive, and oil pump and filters. These parts all detach with the timing cover and do not necessitate interference with any gears.

The Minor has a special cylinder designed to dispense with the usual long holding-down stud, thus, it is claimed, mini-



(Left)
The Merlin, latest Rolls-Royce type of which illustrations are permitted, is the liquid-cooled power unit of several high - performance military types.



(Right)
The Kestrel XVI gives 745 b.h.p. maximum at 14,500 ft. A V.P. airscrew can be fitted.

mising risk of cylinder-head distortion. It is machined from high-grade steel and located in the crank case by spigots and secured by four short bolts. Two compression rings and one scraper are carried on each Y alloy piston, which has a fully floating gudgeon pin. The crankshaft, a steel forging, is carried in five plain bearings; the rear end is fitted with a gear to operate the vertical magneto drive shafts, while the front carries a train of spur gears driving the camshaft. The maximum output of the engine is 90 b.h.p. at 2,600 r.p.m.

COVENTRY VICTOR

TWO horizontally opposed four-cylinder engines of 1,500 and 1,600 c.c.s capacity are manufactured by Coventry Victor Motor Co., Ltd., of Cox Street, Coventry. The side-valve, air-cooled cylinder head and barrel are cast in one piece. Bronze-backed white-metal bearings carry the four-throw crankshaft in an electron crankcase. The big ends have white-metal bearings and a deep groove ball race takes airscrew thrust and load.

DE HAVILLAND

THE well-known inverted air-cooled four-cylinder Gipsy Major, made by the De Havilland Aircraft Co., Ltd., Hatfield Aerodrome, Herts, needs no introduction. The forged crankshaft is carried in five plain bearings in the aluminium alloy crank case with close-fitting Elektron top cover. The split big-end bearings are of bronze-backed white metal. Cast alloy pistons are fitted, and the aluminium-bronze head needs no plug adaptor or separate valve seatings. Accessories are mounted on the timing gear cover. A Claudel Hobson down-draught carburetter supplies the mixture. It is stated that 750 hours running is possible between complete overhauls.

A direct development of the Series I, the Gipsy Six Series II, is specially designed for use with V.P. airscrew and fuels of high octane value. The six cylinders are deeply spigoted into the Elektron crank case, which supports eight steel-backed white-metal bearings to carry the nickel-chrome crankshaft. The top cover carries two B.T.H. magnetos, distributors and driving gear. One inlet and one stellited exhaust valve per cylinder bed directly on high-expansile steel seats.

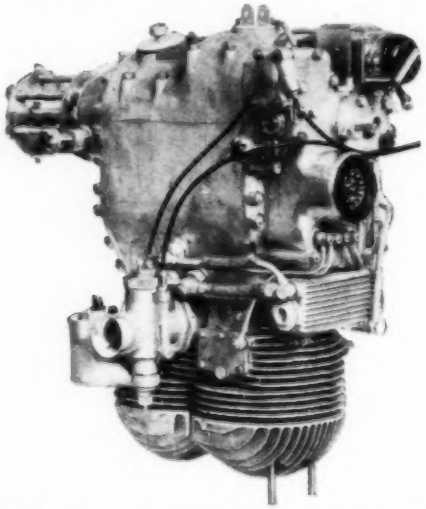
Valve operation is through steel rockers and hollow alloy push-rods from the port side camshaft, which is driven by spur gears from the front end of the crankshaft, together with all auxiliary drives, including the vertical fuel pump and oil pump drive.

Mixture is supplied from two Claudel Hobson carburetters, the flame-trap flaps being synchronised with the throttle lever to prevent "freezing" at cruising r.p.m. but to give best performance at full throttle. The maximum output with a fixed pitch airscrew is 205 b.h.p. at 2,400 r.p.m. on 77 octane fuel. This becomes normal output when a V.P. airscrew is fitted. The aim in the Series II engine is to maintain higher consistent power output.

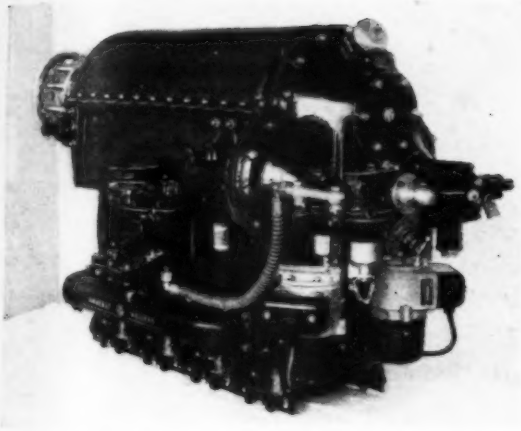
A new inverted vee-twelve, air-cooled, geared and supercharged engine is now being produced, to be called the Gipsy XII. The b.h.p. is in excess of 500, but further information is not yet available.

J.A.P.

A COMPARATIVE newcomer to the British light Aero engine market is the J.A.P.-built flat twin of 1,860 c.c. capacity. The nickel-steel crankshaft runs in three roller and ball bearings and the split "I" section big ends have special roller bearings. Roller tappets and enclosed rockers operate two valves per cylinder, while the rocker boxes are integral



The 16/28 b.h.p. Scott. A trim little two-stroke with three-piece crank case.



The air-cooled four-cylinder-in-line, Villiers Maya has the head design and splayed valves of a radial-type engine.

with the heat-treated alloy heads, bolted to the chrome-molybdenum steel cylinders, which have machined fins. The bronze valve seats are shrunk into the heads.

Double gear type scavenging and pressure-feed oil pumps deal with lubrication, the oil being retained in a separate finned portion of the alloy crank case.

Standard fittings include one B.T.H. two-spark magneto driven from the rear end of the crankshaft, Zenith carburetter with exhaust-heated intake, and an all-metal oil filter. Distributors are the Aircraft Exchange and Mart, Ltd., 7, Park Lane, London, W.1.

NAPIER

OF unorthodox and distinctive design the Rapier and Dagger engines are of the sixteen and twenty-four cylinder "H" type. The crank case is split horizontally and on each side there is a crankshaft driven by two banks of four or six cylinders, one upper vertical and one lower inverted. These crankshafts, carried in lead-bronze bearings, have pinions directly engaging the larger gear of the propeller boss; this reduction gear and connecting gear for the twin shafts is in one unit.

The cylinders have screwed-on alloy heads and forged alloy pistons with one scraper and two compression rings, while the hollow, fully-floating gudgeon pins have their phosphor-bronze bushes pressure-lubricated. The connecting-rod assembly for each consists of a forked rod with fixed, lead-bronze-lined steel bearing shell, and a plain rod which oscillates on the outside of the bearing shell. The assemblies are arranged in groups of three; the front three starboard and rear three port plain rods are attached to pistons in top cylinders, and in the other cylinders the position of forked and plain rods is reversed.

Two totally enclosed overhead valves per cylinder have stellited seats inserted in the head, and each carry two coil springs. The actuation is from push-rods and an upper and lower central camshaft. The drive for these camshafts and also the Watford magnetos, air compressor, petrol and oil pumps, tachometer, gas distributor and generator is taken from a very neat and compact wheel case interposed between crank case and supercharger. The drive for the last named is from an airscrew hub extension through layshaft, differential, and friction plate clutch.

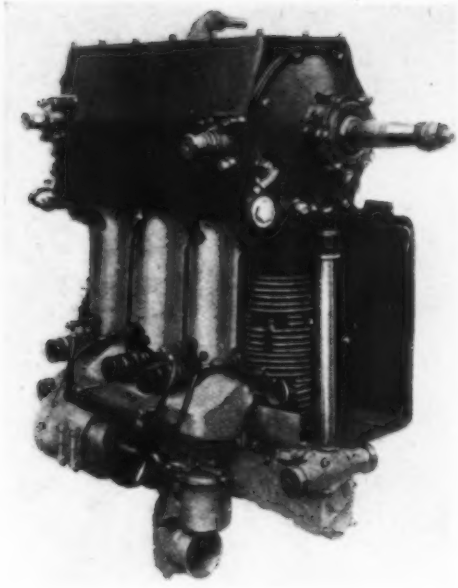
An automatic boost control is fitted and the special Napier Claudel-Hobson carburetter mounted above the supercharger is oil jacketed around intake volute and choke. An elaborate system of finning and baffling, with air chutes ensuring efficient cooling, is supplied for tractor installation.

The Napier-Junkers Culverin is a six-cylinder vertical two-stroke opposed-piston compression-ignition engine, the twin crankshafts, one above and the other below, being connected through a train of gears. Main bearings are of phosphor bronze and the two pistons in each steel liner of the Hiduminium engine casting are of aluminium alloy. The lower piston controls induction and the upper exhaust.

D. Napier and Son, of Acton, London, W., are the manufacturers.

PHILLIPS AND POWIS

SOON to be made under licence by Phillips and Powis, of Reading, from the American Menasco Company, the Pirate and Buccaneer models, four-and six-in-line respectively, are



The 2,000 c.c. Weir, the smallest British inverted, in-line four-cylinder engine has an "underhead" camshaft.

both available in supercharged or normally aspirated forms. These engines are unusually easy to service. The aluminium alloy heads are detachable from the nickel-iron cast cylinders, which have deep spigots extending into the crankcase as oil baffles and are held down by long bolts. A single camshaft inside the crankcase operates push-rods between the cylinder and roller bearing rockers. The bronze valve seats and plug adaptors are screwed, shrunk and pinned in.

Pistons are of "waffle head" design and he 11in. nitraloid gudgeon pins have bronze-backed, babbit-metal-lined bearings on the forged duralumin connecting rods. All the bearings are of this composition.

The Menasco superchargers have machined, forged impellers and long exposed intake manifolds giving an inter-cooling effect. Up-draught carburetters are fitted to the C_4 and B6 and the downdraught type to the supercharged C_4S and B6S. Twin Bosch magnetos supply current to two plugs per cylinder on the Buccaneers, and Scintilla magnetos are alternatives for the Pirate.

POBJOY

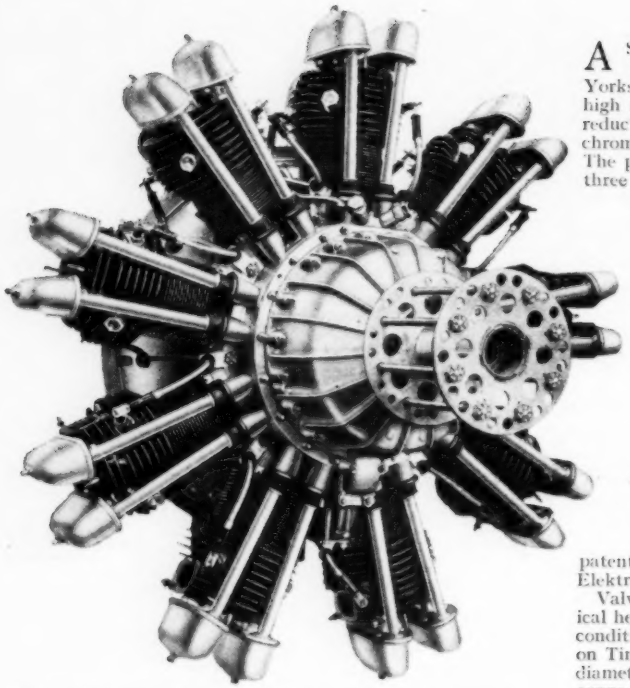
POBJOY AIRMOTORS, LTD., of Rochester, Kent, have further developed their Niagara and Cataract types. The engine is one of the smallest and most compact radials made. The seven steel cylinders have die-cast duralumin heads, screwed on, and each head has two valves with totally enclosed, automatically lubricated push-rods, and roller bearing rockers mounted on patented brackets for expansion compensation.

A built-up crankshaft with ball-bearing endwise location has a case-hardened crankpin. The six articulated connecting rods are linked to a hardened eye on the one-piece master rod, which has a floating bronze bush bearing. The aluminium alloy crankcase is in four parts, the two central sections being split in the plane of the cylinders and carrying the main roller bearings. The front section carries shock-absorber reduction gear, front bearing and main thrust bearing. The rear section houses cam-gear and carries two magnetos and oil-jacketed carburetter with controlled hot and cold air intake.

The Cataract III has compression plates under the cylinders giving a ratio of 5.8: 1, as compared with the normal 6: 1, and is in effect a de-rated Niagara III. Advanced, supercharged radial engines are in the experimental stage at Rochester.

ROLLS-ROYCE

THE Rolls-Royce Kestrel range (Rolls-Royce, Ltd., Derby) is well-known to everyone and is one of the most successful engine types ever produced. Of the 60 deg. vee-twelve,



The Wolseley Scorpion Mk. II gives 295 b.h.p. maximum at 2,600 r.p.m.

water-cooled design, the cast aluminium blocks carry steel liners made gas-tight with soft aluminium rings between the top edge and head and rubber rings at the lower end. Renewable valve seatings and plug adaptors are screwed into the heads, nickel-manganese chromium composition for the exhausts and aluminium-bronze for the inlets and adaptors. Fuel and water jackets are cast integrally with the walls and flanges on the liners bear directly on the crankcase, the complete unit being held down by fourteen large studs.

Pistons are machined "Y" alloy forgings each with one scraper and three compression rings below and above the fully floating silico-manganese steel gudgeon pins, which are located sideways by spring circlips. The Kestrel XVI has an additional scraper ring above the gudgeon pin. The "H" section forged connecting rods are machined all over and each crankshaft throw carries a pair of rods, one of which is forked. The big end and main bearings are of lead-bronze, the former being spun on steel shells held by caps on which the seven-bearing crankshaft is supported.

The valves, four to each cylinder, are operated by overhead camshafts; each has a separate rocker and two coil springs, and the exhaust valves are sodium-filled.

A reduction gear unit of the single spur-gear type (in a cast aluminium housing) is bolted to a machined face on the crankcase front; three ratios are available, 0.477, 0.553 and 0.642. The wheel case is located immediately behind the crankcase and houses drives to twin Watford or B.T.H. magnetos, petrol pump, hand starter mechanism, gun gear drive, water pump and oil pumps and camshafts. The gas-starter distributor and tachometer drive, are taken from the camshafts. In the case of normally aspirated X, XI and XII engines a generator drive and housing completes the rear assembly, twin Rolls-Royce Duplex carburetters being located between the cylinder blocks. In the fully supercharged KIV, V, VI, XVI and moderately supercharged VII, VIII and IX engines the ratio of supercharger impeller to crankshaft is 8.8-1 and 6.92-1 for the two classes respectively.

The newly developed Merlin engine follows the Rolls-Royce practice of 60 deg. vee design, with twelve cylinders and water cooling. The cylinder heads are detachable and the top water pipe of the Kestrel is replaced by a cast aluminium manifold. It has enclosed wiring and the plugs are sunk in the head assembly. The external design of carburetter and supercharger differs from that of the Kestrels though the XVI, like the Merlin, has the air intake downwards.

SCOTT

A SMALL two-stroke in-line twin of 652 c.c. capacity is manufactured by the Scott Motor Cycle Co., of Shipley, Yorks. The maximum b.h.p. at 4,000 r.p.m. is 28, which is high for a weight of only 85 lb. complete with spur-type 2:1 reduction gear. The cylinders are of light alloy with encast chromium liners, and the heads, also of alloy, are detachable. The pistons have special skirts and are of die-cast alloy with three compressor rings and scraper grooves. A step-up and two scavenge pumps are used in the Scott patented lubrication system, which proportions the oil flow and pressure according to load and revs.

Drives, including rev. counter and magneto, are taken from an airscrew shaft extension.

The two main bearings are of the roller type and a large triple-row race supports the big ends on the special built-up crankshaft. One deep-groove ball race in the reduction gear takes thrust, at the same time supporting the airscrew boss.

VILLIERS HAY

THE four-cylinder-in-line "Maya" air-cooled engine is the forerunner of a range of six-in-line and twelve-cylinder engines, of both normally aspirated and supercharged types. This small edition, which has gone through exacting Air Ministry tests, gives 130 h.p. maximum at 2,600 r.p.m. The small frontal area and absence of vibration are noticeable points. Special patented twin camshafts run on four bearings direct in the Elektron case.

Valve gear is incorporated giving a more efficient hemispherical head design, with splayed valves and ample cooling for all conditions by means of deep, close finning. The rockers run on Timken taper rollers to take side thrust and operate large-diameter ball-ended tappets. Hot-pressed high-duty alloy connecting rods, with white-metal big ends, carry large fully-floating gudgeon pins and "Y" alloy pistons with three compression and two scraper rings apiece. The thrust of the airscrew hub, which is integral with the crankshaft is taken by a deep-groove ball journal bearing. Auxiliary drives are taken from the rear of the camshafts. A Claudel Hobson down-draught carburetter is located on the port side. Fourteen-millimetre plugs and stellited exhaust valves are other items in the specification. The makers are the Villiers-Hay Development Co., Albemarle Street, London.

WEIR

THE four-cylinder Weir engine, designed originally for use in the Weir Autogiro, gives 45 h.p. normal output and a maximum of 50 h.p. at 2,550 r.p.m. The design is simple, incorporating dual ignition and single pressure and duplicated scavenge oil pumps. There are also five readily accessible oil and fuel filters.

This smallest of British inverted, in-line "fours" has an "underhead" camshaft with a rear drive. Provision is made for an Amal fuel pump. The weight of 112lb., which includes air scoop, baffles and airscrew hub is very low. The makers are G. and J. Weir, Ltd., Cathcart, Glasgow, S.4.

WOLSELEY

THERE are three current Wolseley models, the Aquarius Mk. I and Scorpio Mk. I and II. The Aquarius is a seven-cylinder air-cooled radial type giving a maximum output of 170 b.h.p. The Scorpio I and II are nine-cylinder normally aspirated and moderately supercharged types, the latter being rated at 6,000 ft. and giving a maximum of 295 b.h.p.

The standardised alloy crank case is split in the plane of the carbon steel forged cylinder and carries a built-up crankshaft. The master rod, with solid big end, is located in the top cylinder. The aluminium alloy heads have horizontal finning, and a single cam ring running on ball bearings operates both inlet and exhaust valves *via* push-rods and rockers.

Actually, production of these engines recently ceased, and at the moment there is doubt whether it will be resumed. Wolseley Aero Engines, Ltd., Birmingham, were the makers.

Stainless Steel Castings

"RUST-, Acid- and Heat-Resisting Steel Castings" is the title of the latest brochure issued by Firth-Vickers Stainless Steels, Ltd., Staybrite Works, Sheffield, 9. It gives a good idea of the immense variety of work obtainable from their stainless-steel foundry, which is now in full operation.

BRITISH MILITARY AIRCRAFT

The fastest military aeroplane in the world : The Supermarine Spitfire.

Some of the World's Finest Service Aeroplanes Reviewed

Illustrated Mainly with "Flight" Photographs and Sketches

SINCE *Flight* last reviewed the range of British aircraft some of the finest military machines now in existence have been flown, tested, and adopted by the Royal Air Force.

The fastest fighters and bombers in the world are actually in quantity production in this country, whereas the majority of foreign types are still experimental.

In every category our latest military machines are supreme.

Only a limited amount of data on these new models is available, but such information as is permitted to leave the hands of the manufacturers is incorporated in the following notes.

Apart from these semi-secret machines it will be seen that there are types whose performance sheets are open to the gaze—and admiration—of prospective buyers.

AIRSPEED

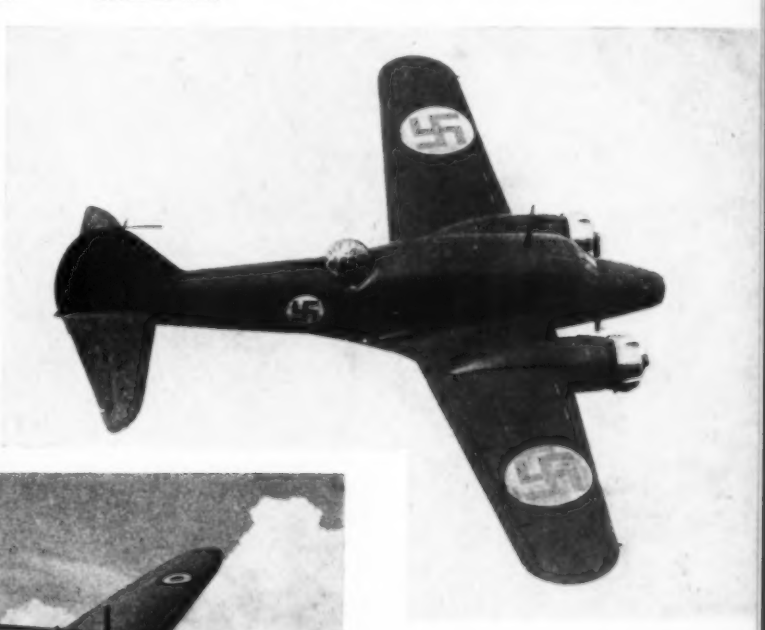
A SOUNDLY designed commercial aeroplane can often be converted or developed into a surprisingly efficient military type, as witness the Airspeed Envoy with its "Convertible" and "Trainer" variations.

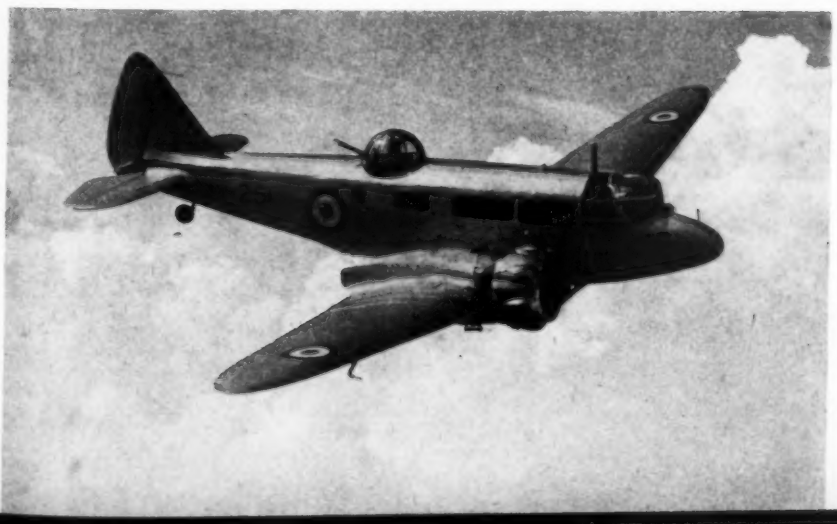
The basic design of the standard civil Envoy is dealt with fairly fully in the appropriate section of this issue. The Convertible Envoy is essentially of the same design but adapted for conversion, by four men in four hours, into a fast medium bomber or reconnaissance machine. In both cases the armament consists of a fixed gun for the pilot and a free gun in an Armstrong Whitworth turret. A bomb load, varying with individual requirements, can be carried.

The Airspeed Trainer, which has been in the limelight of late in connection with its adoption by the Air Ministry for specialised training, is structurally similar to the Series III Envoy but has dual control, the pilots' position having been moved farther aft. A gun turret is mounted and homing and direction-finding gear is installed in addition to normal receiving and transmitting equipment. The engines of the production type will be Siddeley Cheetah IXs driving De Havilland variable-pitch airscrews, which should confer a sufficiently high performance to provide thorough training for pilots who will subsequently pass to high-speed, multi-engined bombers.

ARMSTRONG WHITWORTH

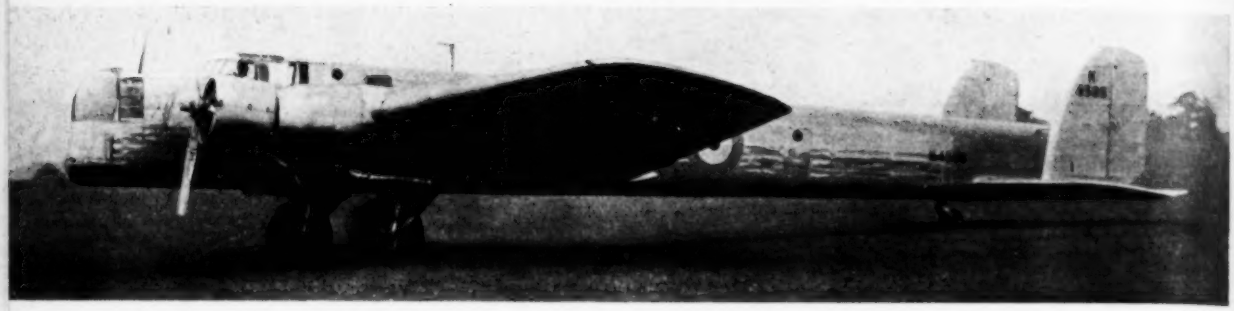
A LARGE number of Whitley heavy bomber aircraft, destined for service with R.A.F. squadrons, has been ordered from Sir W. G. Armstrong Whitworth Aircraft, Ltd., of Whitley, Coventry. Many of the Whitley's features, particularly the wings, are similar to those of the A.W.23 bomber-transport monoplane which preceded it, but the machine is planned purely as a high-speed long-range bomber, whereas the "23" monoplane was intended for transport duties as well.



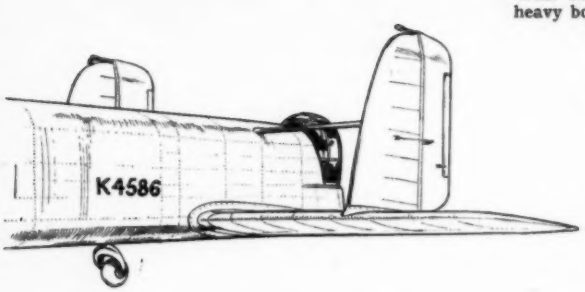


The particular Avro Anson shown above is one of a batch for Finland. Similar machines are used in large numbers by the R.A.F.

The Airspeed Convertible Envoy is shown here equipped as a fast medium bomber.



With two 795 h.p. Tiger IXs the new Armstrong Whitworth Whitley heavy bomber has a fine performance for a machine of its size. On the left is a sketch of its tail, showing the rear gun turret.



The performance, due mainly to the smaller fuselage, is believed to be much higher.

The single cantilever main plane (the Whitley is actually a mid-wing type) tapers in chord and thickness and is built on a single box-spar of corrugated light-alloy sheet. A similar form of construction is used for the tail plane. Split trailing-edge flaps are incorporated and effect a marked reduction in landing speed. Each half of the hydraulically retractable undercarriage is mounted beneath an engine nacelle and embodies steel springs and oleo shock absorbers.

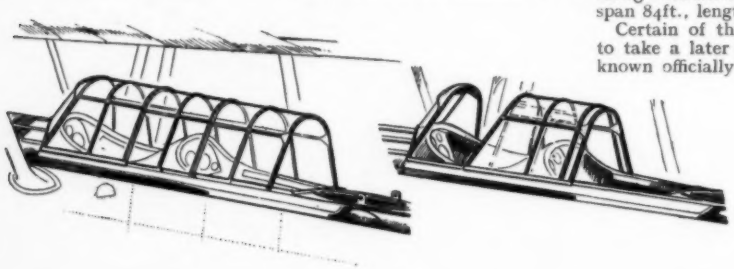
Power is supplied by two 795 h.p. Siddeley Tiger IX engines mounted on the main wing spar by tubular steel structures embodying the Armstrong Siddeley flexible engine-mounting. The airscrews are of the three-bladed variable-pitch De Havilland type.

Two pilots, two gunners and one wireless operator form the crew of the Whitley. Armstrong Whitworth balanced gun turrets are fitted in the extreme nose and tail. This form of turret shields the gunner from the airstream by a transparent cupola and is arranged so that the weight of the machine gun is balanced by the weight of the gunner. This fact, combined with the air-balancing of the gun barrel, makes the device practically effortless in operation.

Figures for the weight and performance of the Whitley are being withheld but the main dimensions are as follows: span 84ft., length 69ft. 3 in., and height 12ft. 9 in.

Certain of the Whitleys for the R.A.F. are being adapted to take a later type of Tiger than the Series IX and will be known officially as Whitley IIs.

The Boulton Paul Overstrand medium bomber was the first machine with a power-driven gun turret to be adopted by the R.A.F.



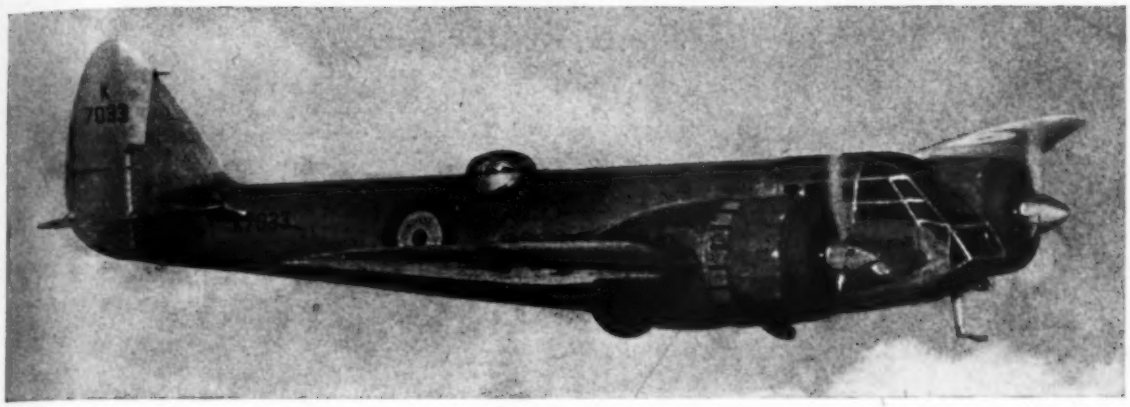
BLACKBURN

THE only modern military, or, more correctly, naval, type of Blackburn design which it is permissible to describe at the moment is the Shark, a two-three seater biplane intended for coastal defence and for service with the Fleet. This model has been adopted as standard equipment by the Royal Air Force, the Canadian Air Force and the Portuguese Government, and is extensively operated both as a seaplane and on wheels.

Although the Shark is usually powered with a Siddeley Tiger, a Bristol Pegasus-engined version has also been constructed at the Brough (E. Yorks) works of the company, and put up a convincing performance at this year's S.B.A.C. display.

The metal fabric-covered wings of the

The Blackburn Shark is seen on the left in its seaplane form. Above it are details of the cockpit enclosure which has been developed for this machine.



The Mercury-engined Bristol Blenheim is the fastest bomber in the world and has been adopted as a standard R.A.F. type.

Shark are of sesquiplane form and are designed to fold without jury struts. Their interplane bracing takes the form of a group of N struts of steel tubing. Of even greater interest is the monococque fuselage consisting of transverse frames, longitudinal stringers and shell plating of Alclad. The centre and rear portions are arranged as watertight compartments.

There are normally two machine guns, one, for the pilot, being fixed and firing through the airscrew arc, and the second, on a disappearing mounting, in the rear cockpit. Provision is made for carrying any normal type of torpedo up to a maximum weight of about 1,500lb. on a Blackburn patent torpedo carrier. Alternatively, approximately the same weight of bombs can be handled.

The undercarriage is a very sturdy divided type with wheel brakes, and the tail wheel is sprung by an oleo strut. Arrester gear is easily incorporated for deck-landing.

With the 643 h.p. Siddeley Tiger IV engine and operating as a spotter-reconnaissance machine the

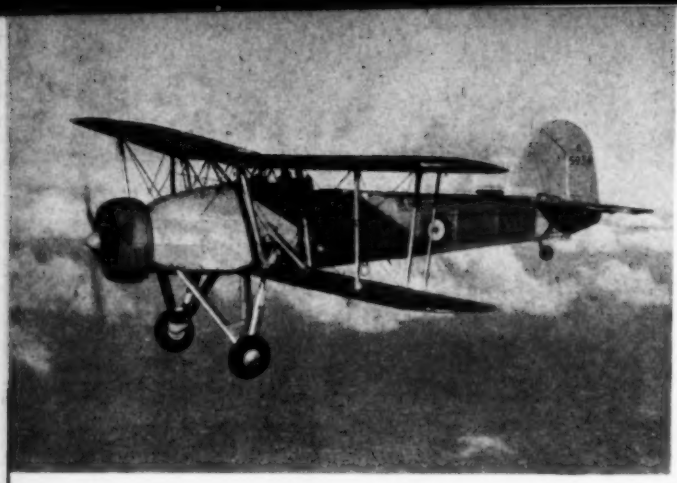
A particularly versatile type in the heavy category is the Pegasus-powered Bristol 130 bomber-transport.

Shark does nearly 160 m.p.h. and has a service ceiling of 20,400ft., but with the Tiger VI, which gives 760 h.p., these figures are considerably improved.

BOULTON PAUL

IN the military field Boulton Paul Aircraft, Ltd., now of Wolverhampton, are best known for their medium bomber machines, represented in the R.A.F. to-day by the Overstrands which equip No. 101 (Bomber)

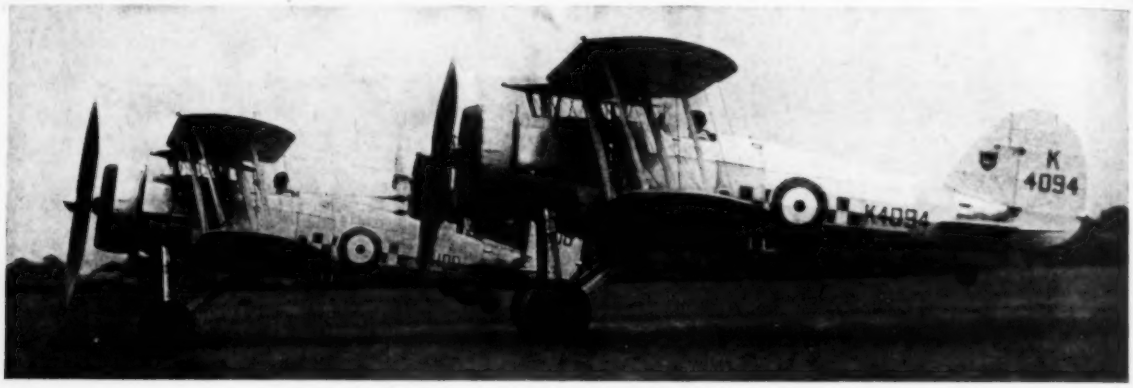
The Fairey Battle high-performance medium bomber has one of the new Rolls-Royce Merlin engines. The view on the right shows the D.H. variable-pitch airscrew and the retractable undercarriage.



The Fairey Swordfish (left) is a torpedo spotter reconnaissance type used by the Fleet Air Arm.

which large numbers have been ordered, as the Blenheim, the machine concerned bears the Bristol works number 142M, indicating that it is a direct development of the type 142 civil monoplane built to the order of Lord Rothermere and presented to the R.A.F.

The Blenheim is classed officially as a medium bomber, and is an all-metal, mid-wing cantilever monoplane powered with two of the new Bristol Mercury VIII radial engines rated at 825 h.p. at 13,000. These units drive three-bladed De Havilland controllable-pitch airscrews, and their long-chord cowl-



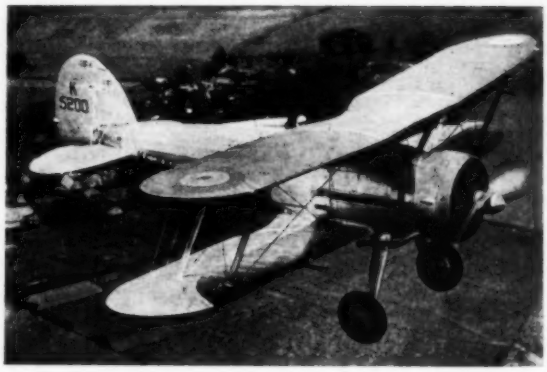
The Mercury-engined Gloster Gauntlet is well established in the R.A.F.

squadron. Although the Overstrand cannot be counted as a modern design (it is a direct development of the Sidestrand machine which entered the Service many years ago), it has a number of features and qualities of quite unusual merit.

Its manœvrability has been amply demonstrated at Royal Air Force Displays and its good take-off, climb and general "niceness" are vouched for by pilots who have flown it.

Structurally the Overstrand is a twin-engined biplane with wings of equal span and high aspect ratio. A crew of three is accommodated and there are the same number of gun positions (nose, top fuselage and bottom fuselage), the two rear positions being alternatives.

Of special interest is the patent Boulton Paul power-driven gun turret provided for the gunner in the nose of the fuselage. This device consists of a transparent cylinder, being held in position as an egg might be gripped at each extremity by finger and thumb. The barrel of the machine-gun projects through a vertical slot and is movable over the entire vertical range, and the weight of the weapon is balanced against that of the gunner. As the gun is aimed to the right or left its movement sets in operation a reversible pneumatic motor which rotates the turret in the desired direction at about 12 r.p.m.



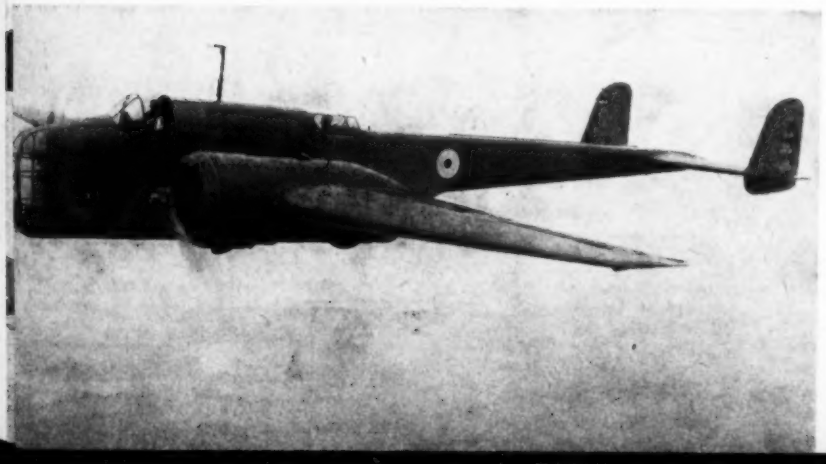
Four guns are carried on the 255 m.p.h. Gloster Gladiator, a development of the Gauntlet.

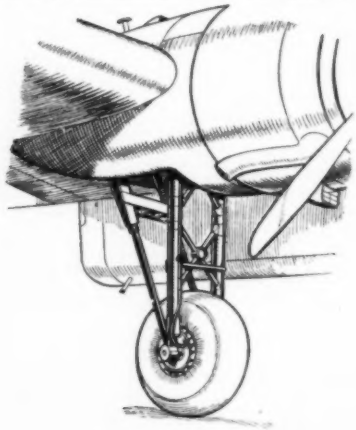
BRISTOL*

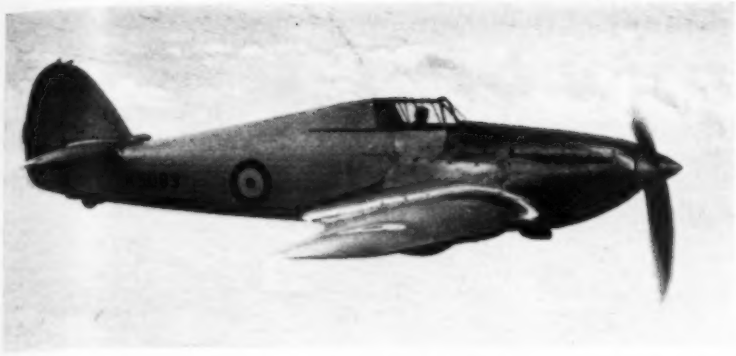
TO the Bristol Aeroplane Company, of Filton House, Bristol, goes the credit for having constructed the fastest bombing aeroplane in the world. Known to the Royal Air Force, for

* Exhibiting at Paris Show.

The striking lines of the H.P.52 medium bomber are well brought out below. On the right is a detail of its retractable undercarriage.







Powered with a Rolls-Royce Merlin, the Hawker Hurricane has an extremely high performance. It has been adopted by the R.A.F.

ings embody controlled cooling systems which limit the flow of cooling air to necessary proportions for various flight conditions. The undercarriage is an hydraulically operated retractable design and folds away into the engine nacelles. Split trailing edge flaps are specified to facilitate landings and take-offs.

Normally a crew of three is carried. Figures for weight and performance are withheld at the request of the Air Ministry, but it may be recalled that the civil 142 type on its initial test flights clocked 280 m.p.h. at 14,000ft., and that subsequent improvements benefited performance very considerably. This machine was originally fitted with engines considerably less powerful than those of the Blenheim.

The main dimensions of the Blenheim are: Span 56ft. 6in., length 39ft. 9in., and height 9ft. 9in.

A second interesting Bristol model, also accepted as standard equipment by the R.A.F., is the Type 130 bomber-transport, a large, all-metal high-wing monoplane with a pair of 810/850 h.p. Pegasus X engines. As a bomber the machine is fitted to carry a crew of four and a heavy projectile load, while in its "transport" form the crew is reduced to three and the spacious fuselage is arranged to accommodate twenty-four fully armed infantrymen with a certain amount of provisions. Such items as spare engines are easily handled. Fully laden the aircraft weighs about 18,000 lb.

The main dimensions of the 130 are: Span 96ft., length 67ft. 9in., and height 16ft.

At this time great interest centres around the Bristol 138 monoplane, which holds the world's altitude record, having climbed to 49,967ft. This machine, although the property of the Air Ministry and flown by a Service pilot, can hardly be considered as a military type, but doubtless it will provide data affecting the design of future Service machines. A description was given in *Flight* of October 1, 1936.

DE HAVILLAND

THE latest contribution by the De Havilland company to the military range is an advanced-training low-wing monoplane now under construction at their Hatfield (Middlesex) works. This type is planned to meet Air Ministry requirements and mounts one of the new De Havilland Gipsy Twelve inverted vee air-cooled engines, delivering over 500 h.p. and driving a D.H. constant-speed airscrew.

Apart from military versions of certain of their civil types, notably the Dragon and Rapide, the company is offering the Tiger Moth, which, they claim, reproduces in exact parallel, but on a reduced scale, the handling characteristics and performance of many modern, high-speed Service types. It is suitable for *ab initio* training, instruction in fighting, aerobatics, bombing, wireless, photography, reconnaissance, army co-operation, blind flying and night flying. With its Gipsy Major engine of only 130 h.p. the machine is economical to operate. As landplane it does 110 m.p.h. or, on floats, 104 m.p.h. The type is used extensively by the R.A.F.

A typical Hawker two-seater biplane: the Hind light bomber (R.R. Kestrel V) as used by the R.A.F.

FAIREY

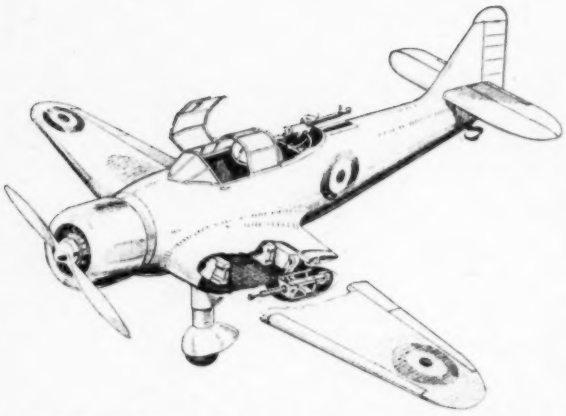
A SINGLE-ENGINED representative of the medium bomber class, the Fairey Battle is one of a number of types in this category ordered in quantity for the equipment of certain R.A.F. squadrons. At the time of its introduction it was stated that slightly over ten minutes after leaving the Fairey aerodrome at Heath Row, Middlesex, the Battle could be over the South Coast of England, some 45-50 miles away; that is the only indication of its performance which may be published.

Laid out as a two-seater, low-wing cantilever monoplane, the Battle has a supercharged Rolls-Royce Merlin engine, which now drives a three-bladed De Havilland variable-pitch airscrew, and is fitted with split trailing-edge flaps and a semi-retractable undercarriage.

Showing the clean installation of the Hurricane's Merlin engine and the arrangement of the retractable undercarriage.

Stressed-skin construction is employed throughout, except for the control surfaces, but this does not prevent the internal stowage of the substantial bomb load.

A somewhat unusual operating gear is used for the under-



Most of the features of the projected Parnall light military general-purpose monoplane are brought out in this sketch.

carriage, the rods of the hydraulic rams projecting at an angle of about 45 degrees behind the telescopic struts. Each wheel is mounted on a single semi-cantilever leg.

The extraordinary manœuvrability of the Battle has been demonstrated at the R.A.F. and S.B.A.C. Displays, its slow rolls, loops and upward rolls speaking volumes for its handling qualities.

An automatic pilot is installed to assist on long flights and when flying in cloud, mist or darkness.

The chief dimensions of the Battle are: span 54ft., length 42ft., and height 13ft.

Apart from building large quantities of Battles, the Fairey Company is delivering to the R.A.F. a number of Hendon heavy bombers, each with two fully supercharged Rolls-Royce Kestrel engines.

A third, and particularly versatile, Fairey model which has been adopted by the Service, and is, in fact, in extensive use with the Fleet Air Arm, is the Swordfish, a two-three seater biplane designated officially a torpedo spotter reconnaissance machine. This model has a 690/750 h.p. Bristol Pegasus III moderately supercharged engine, is available with wheel or float undercarriage, and can handle a heavy loads of bombs or a torpedo.

The Swordfish, as used by the Fleet Air Arm, is equipped with flotation gear and has arresting equipment for deck landings.

It is contrary to the policy of the Fairey Company to issue performance figures for publication.

GLOSTER

TWO closely related single-seater biplane fighters are the only current Gloster models which it is permissible to describe. Known as the Gauntlet and Gladiator, both machines are in large-scale production at the Hucclecote (Gloucestershire) works of the company, both for the Royal Air Force and foreign Governments.

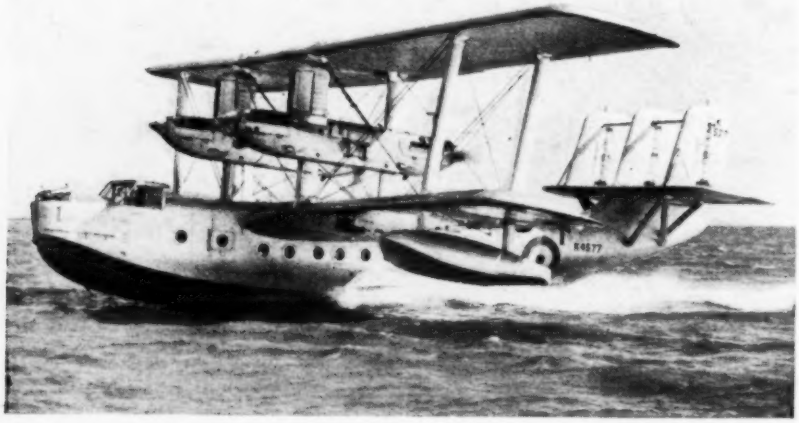
The Gauntlet is of two-bay design and powered with a Bristol Mercury VIS radial of 605 h.p. Structurally it is all-metal with fabric covering. Square tubing is utilised for the forward portion of the well-faired fuselage, the joints being of the flat-plate type, secured by hollow rivets. The rear section is built up from round tubes and has wrapper-plate type joints and tie-rod bracing. The wings are exceptionally stiff and incorporate spars of high-tensile steel strip, the ribs being of duralumin.

The Gladiator is a more recent type and has been developed directly from the Gauntlet. One distinguishing feature is the single-bay arrangement of the wings, which have been designed to give the same rigidity as those of the two-bay machine. The undercarriage of this model is of the single-strut cantilever type employing Dowty internally sprung wheels.

Although carrying some hundreds of pounds more fuel and equipment than its forerunner, the Gladiator shows increased performance, even with the same engine. As ordered by the R.A.F. the Gladiator mounts one of the new Bristol Mercury IX engines (840 h.p. at 14,000ft.), and shows a top speed of 255 m.p.h. at 15,500ft. With full load, including four machine guns (two in the fuselage and two in the wings), night flying gear and wireless, the Gladiator will reach 20,000 ft. in nine minutes. Its stalling speed is under 60 m.p.h., and the absolute ceiling no less than 35,500 ft.

In the latest version an enclosure is provided for the pilot, for whose cockpit an efficient heating system is supplied.

A sturdy, seaworthy flying boat now being issued to certain R.A.F. units is the Saro London, which has two Bristol Pegasus engines.

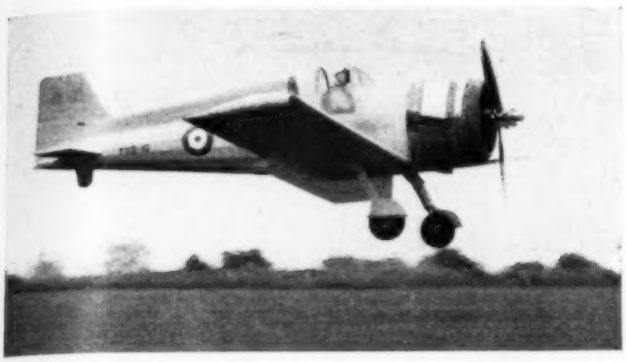


The tandem disposition of the engines (four Rolls-Royce Kestrels) is but one of the striking features of the Short Singapore III being used by, and still produced for, the R.A.F.

HANDLEY PAGE

THE Cricklewood (London) works of this company are at present in full production with two types of bombing aircraft incorporating a number of advanced features. The machines concerned are the Type 52 medium bomber and the Harrow heavy bomber, the prototypes of both models being powered with Bristol Pegasus engines.

The "52," in appearance and performance, is one of the most striking military aeroplanes of



Few more fitting names could have been chosen for the small Aquila-engined Vickers fighter than "Venom." The sketch on the right shows details of its engine installation, cockpit enclosure and electrically operated retractable undercarriage.

recent times. Built to meet Air Ministry Specification B.9/32 it is a mid-wing cantilever monoplane of stressed-skin metal construction embodying such modern aids to performance as Handley Page slots and flaps and variable-pitch airscrews. The forward portion of the fuselage is exceptionally narrow and deep and houses three gun positions—in the nose, at the lower rear extremity of the box-like forward portion and on top of the fuselage in the plane of the trailing edge. Aft of the rear gun positions the fuselage becomes extremely small in cross section, and in conjunction with the twin-rudder arrangement of the tail gives a very excellent field of fire.

The Harrow heavy bomber is the company's most recent product, the first photographs appearing in this issue. Designed for carrying heavy loads over long distances it is equipped with advanced forms of armament installations. Apart from its functions as a heavy bomber the Harrow has been planned with a view to operating as a troop carrier. There are gun turrets in the nose and tail and amidships.

The installation of Handley Page slots, flaps and of variable-pitch airscrews on the Bristol Pegasus engines enables the machine to operate with heavy loads from small aerodromes. Of metal construction, the Harrow has fabric and metal covering.

Being designed as a high-wing monoplane certain difficulties would present themselves were the undercarriage made retractable, so, instead, the makers have fitted a clean fixed type of landing gear.

Performance trials have given results far beyond the expectations of the technical staff responsible for the design.

The first Vickers machine of full "geodetic" construction was the Wellesley monoplane, now powered with a 850 h.p. Bristol Pegasus X.

HAWKER

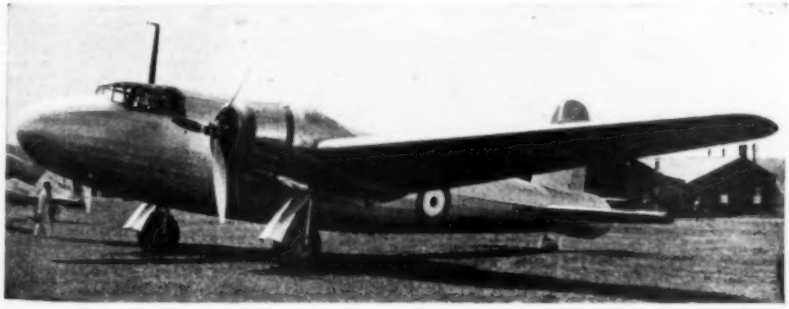
ALTHOUGH single- and two-seater Hawker biplane types are still being built, interest naturally centres round the new Hurricane single-seater fighter, production orders for which have been received from the Air Ministry under the R.A.F. Expansion Scheme.

The Hurricane comes within the "300 m.p.h. plus" category, and was built at the company's Kingston-on-Thames (Surrey) works to meet Air Ministry specification F.36/34. Details of armament, performance and construction are withheld, but it may be stated that the machine is of fairly conventional construction with fabric covering. The engine is a Rolls-Royce Merlin driving, in the prototype, a large two-bladed wooden airscrew. To add that the undercarriage is retractable, that flaps are fitted and that the pilot is completely enclosed seems almost superfluous in view of the extremely high performance.

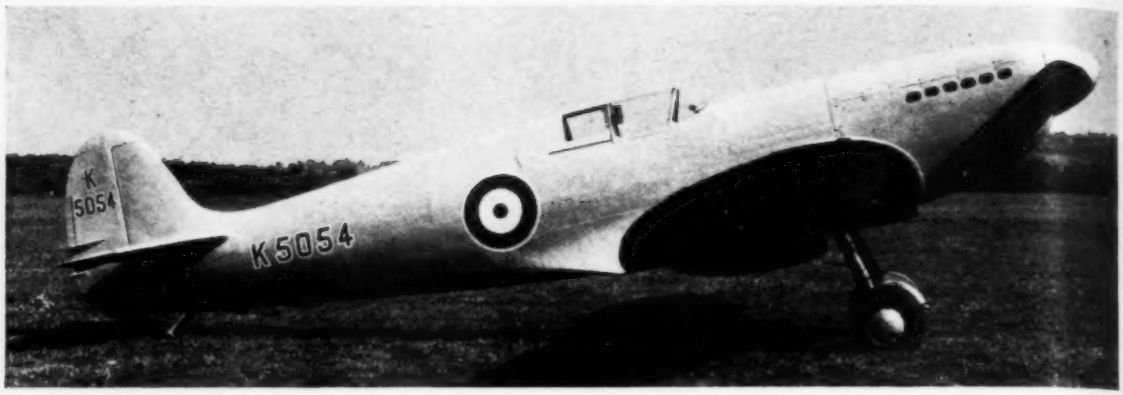
The undercarriage is arranged to retract inboard into the cantilever wing, with a slight rearward motion, the wheel wells being covered during flight by panels moving with the wheels.

Landing lights are housed in the leading edge of the wing (this fact is significant in that no aeroplane which was not docile and without vice during landing would be adopted by the R.A.F. as a night-flying type) and the military equipment is believed to be very comprehensive.

The well-established Fury single-seater fighter biplane, as supplied to the R.A.F., has been developed during the past year; one particularly interesting model



A medium bomber of impressive appearance and performance, the first Vickers twin-engined "geodetic" monoplane has been adopted by the R.A.F. under the name Wellington.



With its Rolls-Royce Merlin engine, the Supermarine Spitfire has a superlative performance and some excellent flying characteristics.

was built for Spain some months ago. This had a single-strut undercarriage, similar to that on the Gloster Gladiator, incorporating Dowty internally sprung wheels. Fitted with a 690 h.p. Hispano-Suiza engine (this unit was adopted for domestic reasons) the machine was capable of 236 m.p.h. at 13,120 ft. Osprey fleet fighter reconnaissance biplanes with similar engines were also delivered. The Osprey, with 600 h.p. Rolls-Royce Kestrel V, is, of course, a standard R.A.F. type, as is the Nimrod single-seater. Large quantities of Hind light bombers (Kestrel V) have also been delivered to the Service, together with Audax army co-operation machines (Kestrel X), Hardy general-purpose types (Kestrel X) and Demons (Kestrel V). At the moment a batch of Hector army co-operation machines is being built. The Hector is fitted with a Napier Dagger III engine giving 725 h.p. at 3,500 ft.

PARNALL

PARNALL AIRCRAFT, LTD., of Yate, Gloucestershire, have designed an interesting little military general-purpose type developed from their Heck civil two-seater described in the appropriate section of this issue. A Wolseley Scorpio II engine of 260 rated h.p. was originally specified and was estimated to give a maximum speed of 199 m.p.h. at 8,000 ft. The following alternative armament installations are provided for: rear gun and two front guns; rear Lewis gun and two 120-lb. bombs; or rear Lewis gun and eight 20-lb. bombs. The fixed front guns are installed in the wings. Dual control can be fitted in a very short time, so the machine would lend itself to advanced training in a large air force, or could be used purely as a fighting or bombing type by impecunious buyers.

A large Pegasus-engined general-purpose biplane was constructed to meet an R.A.F. specification some time back.

PHILLIPS AND POWIS

UP to the present, no Phillips and Powis machine has carried armament, but there are certain products of this Reading (Berkshire) firm to attract the military buyer.

One is the Miles Hawk Trainer with Gipsy Major engine. This model, like all Miles machines, is a wooden, low-wing cantilever monoplane. It is a two-seater open-cockpit type and incorporates split trailing-edge flaps and a new type of single-strut cantilever undercarriage. An Air Ministry order is likely to be placed for a batch of Hawk Trainers for *ab initio* work with the Service. For some time past the type has been in use at the R.A.F. Reserve training school operated by the Phillips and Powis Company.

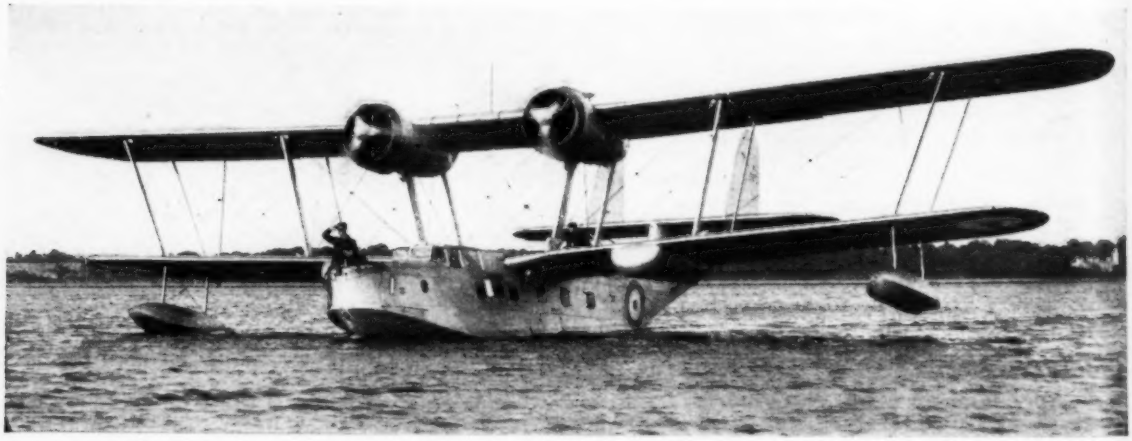
A second type, the Nighthawk, mounts a 200 h.p. Gipsy Six and is a cabin machine, with a speed range from 55 m.p.h. to 175 m.p.h., intended for instruction in "blind-" and night-flying. An exceptionally complete installation of instruments is specified.

A military variation of the Peregrine high-performance twin-engined transport monoplane, dealt with in the civil section of this number, has also been planned and is suitable for training or as a bomber-reconnaissance type.

A. V. ROE

THE Newton Heath (Manchester) Works of A. V. Roe and Co., Ltd., are busy turning out Anson monoplanes for the Royal Air Force and for export. To the Service the Anson is known as a "general reconnaissance" type, and its equipment is planned to meet specific Air Ministry requirements, but, essentially, it may be regarded as a general-purpose machine of great versatility.

A low-wing cantilever monoplane, the Anson has a welded



Supermarine Stranraer flying boats with 850 h.p. Bristol Pegasus X engines are under construction for the R.A.F. Note, in this view, the "bomb tanks" for long-range work.

A pair of Supermarine Walrus naval amphibians with Pegasus engines operating as pushers.

fuselage and wooden wing and is fitted with two Siddeley Cheetah IX engines of 310 h.p. each. The undercarriage retracts into recesses behind the engines, leaving a small portion of each wheel exposed. Flaps are being incorporated in the latest model.

The machine carries a crew of three and a military load ranging between approximately one-half and three-quarters of a ton, according to the range required, this being variable between 425 and 800 miles. In the extreme nose of the fuselage is a position for the bomb aimer, followed, in the order mentioned, by the pilot's cabin (containing a fixed Vickers gun), a radio operator's position, and an Armstrong Whitworth transparent, rotatable gun turret mounted on top of the fuselage aft of the wings. The main cabin is exceptionally light and airy for a military type.

The bombs are stowed within the wing; in fact, the whole design has been kept clean enough to permit a maximum speed of 188 m.p.h. at 7,000 ft. The landing speed, without flaps, is 62 m.p.h., and the absolute ceiling 21,000 ft.

The Royal Air Force has also standardised on the Avro Tutor, a dual-control biplane with Siddeley Lynx engine, and the Prefect, a somewhat similar model equipped for navigational training. Also of military interest is the Mk.II version of the little Genet-Major-engined Cadet which can be employed for preliminary training in photography and in the use of a camera gun, apart from its *ab initio* qualifications.

The Avro 626 is of similar general design to the Tutor, but has a Cheetah engine and has been planned for the training of military personnel in all duties, including *ab initio* work and the operation of all normal armament and Service equipment.

SAUNDERS-ROE

THE London flying boat, already equipping certain units of the R.A.F., is the only current Saro military design which can be mentioned. Numbers of these machines are still under construction at the Cowes works of the company.

The London was designed with a view to obtaining good seaworthiness and comfort, and has, accordingly, a substantial, roomy hull. Above this are biplane wings, the upper set carrying a pair of Bristol Pegasus radials of the Series III of Series X pattern. The latest machines for the Service are having the "X." Stainless steel is employed for the wing structure.

Gun rings are provided in the bows, on the hull decking, aft of the wings, and behind the monoplane tail, which has twin fins and rudders.

With Pegasus III engines the maximum speed is 136 m.p.h. at 5,000 ft., but the installation of the new "Xs" should improve all-round performance quite considerably although the range may be slightly reduced.

A number of Saro Cloud monoplane amphibians with two Siddeley Serval engines are used by the R.A.F. for navigational training.

SHORT

ONE of the most successful flying boats adopted by the Royal Air Force is the Short Singapore III, which is still in production at the Rochester (Kent) works of the Short company.

The Singapore III is unusual in that its four engines (moderately supercharged Rolls-Royce Kestrels of 675 h.p.) are arranged in pairs between the biplane wings, one engine of each pair driving a tractor airscrew, and the other operating as a pusher.

Long range, open sea reconnaissance and coastal patrol are the primary duties of the Singapore III. Forward of the enclosed pilots' cockpit is a gun ring, and behind the wings are two similar mountings, one (arranged to slide laterally) on top of the hull, and the other in the extreme tail.

A speed of 145 m.p.h. is attainable, and the normal range is about 1,000 miles.

SUPERMARINE

THE Supermarine Aviation Works (Vickers), Ltd., have built the fastest military aeroplane in the world. The machine, known as the Spitfire, has been ordered in quantity by the Air Ministry, and is of exceptionally clean design, experience gained in the pioneer work done by the Supermarine Company in the design and construction of Schneider Trophy seaplanes having been utilised. Fitted with a Rolls-Royce Merlin engine the Spitfire is an all-metal low-wing monoplane with retractable undercarriage and wing flaps. The latest technique developed by the manufacturers in the application of stressed skin construction has been used, giving exceptional stiffness for wings and fuselage for a structure weight claimed never before to have been attained with this class of machine. The metal skin covering is perfectly smooth, a point of importance where speeds of over 300 m.p.h. are concerned. The span is 37 ft.

The largest Supermarine type in production is the Stranraer flying boat, a twin-engined biplane developed from the Southampton and Scapa types. The hull is of Alclad with main attachment fittings of stainless steel.

Two medium-supercharged Bristol Pegasus engines are normally specified, those for the Service Stranraers being Pegasus Xs of 850 h.p. each.

The Stranraer operates as a completely self-contained unit with comfortable working and living accommodation for the crew.

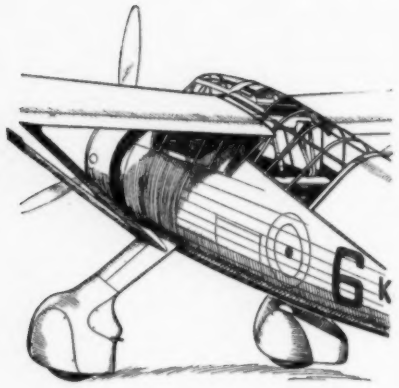
During official trials the severe test of flying with one engine stopped was easily passed, and observation showed that there was no overheating of the engine used to maintain flight.

The third Supermarine type in production is the Walrus single-engined biplane amphibian constructed of duralumin and stainless steel. It is designed for service with warships, being able to fly off the deck of an aircraft carrier on its land undercarriage or operate from a vessel with no flying deck by virtue of its flying boat hull. The wings are easily and quickly folded.

The medium-supercharged Pegasus engine operates as a pusher.

VICKERS

FROM the Weybridge (Surrey) works of Vickers (Aviation), Ltd., have lately emanated three high-performance military monoplanes. In the order of their appearance these types



The sketch above shows the arrangement of the cockpits and undercarriage on the new Westland army co-operation monoplane and the photograph on the right reveals more of its characteristics.

are the Wellesley single-engined bomber, Venom single-seater fighter, and the Wellington twin-engined medium bomber.

The Wellesley was constructed in the first place to conform to an Air Ministry specification for general-purpose aircraft and was soon adopted by reason of its fine performance and excellent load-carrying qualities.

Of all-metal construction, principally duralumin, the Wellesley embodies throughout the Wallis system of geodetic construction, utilising curved, intersecting diagonal members.

The Venom fighter is likewise a cantilever low-wing type, but is not of geodetic construction. In appearance it is striking because of the square-cut tips of the wings and tail plane. One of the new Bristol Aquila supercharged sleeve-valve engines is fitted.

Duralumin is used for most of the structure, the rear end of the fuselage being built according to a new form of monocoque construction giving exceptionally high torsional strength relative to its weight.

Of fine streamline form, the Wellington is a mid-wing design of geodetic construction fitted with two Pegasus engines driving variable-pitch airscrews, flaps and a retractable undercarriage.

WESTLAND

WESTLAND AIRCRAFT, LTD., of Yeovil, Somerset, ha designed, built and flown within twelve months th first aeroplane under their new management. Following t completion of official trials the Air Ministry has placed a su stantial order for the machine, which is a high-wing, singl engined monoplane of unconventional layout designed expres for aerial liaison with ground forces.

The high-wing arrangement has been adopted to give th wide field of view demanded in a Army co-operation typ Placed in front of, and level with, the leading edge of the gu type wings the pilot has an exceptionally fine outlook. H cabin has an abnormally low waistline, and its sides and ro are arranged to slide.

The observer's position corresponds with the trailing ed and is a continuation of the pilot's compartment.

It is possible to cruise at very low speeds, while retaini full stability and control, for spotting and reconnaissan This achievement, together with the slow landing speed, m be attributed to the use of Handley Page wing-tip and ro slots. The operation of the flaps is entirely automatic, th position being controlled by the speed of the machine.

A New Airscrew Factory

IT is now possible to disclose details of plans for the British application of the German Heine airscrew-surfacing process described in last month's issue of *The Aircraft Engineer* supplement to *Flight*.

Jablo, Ltd., of Brettenham House, London, W.C.1, hold the British and Dominion rights of all Heine patents. Under the name of Ipswich Propellers, Ltd., they have arranged with Tibbenhams, the well-known Ipswich furniture makers, to manufacture Heine airscrews at Ipswich. During the great war Tibbenhams made over 30,000 wooden airscrews and several of their then employees are still with the firm. The works manager and others have recently been studying Heine processes in Berlin.

Clydeside Blackburn Factory

BLACKBURN Aircraft Ltd., announce that an agreement is about to be completed between the company and William Denny and Brothers, Ltd., to manufacture aircraft at Dumbarton.

The factory will be laid out immediately at Dumbarton, on ground now owned by Denny Brothers, lying east of their shipyard. It is expected that it will be equipped in about nine months time.

While it is the intention of the firm that ultimately the new factory should specialise in the construction of flying boats, in the first instance it will be employed in the production of one of the types of machines required by the Air Ministry programme.

In connection with the developments it is interesting to note that Mr. A. T. S. Groombridge, M.I.P.E., who has been connected with the De Havilland Aircraft Company almost from its inception at Stag Lane, has now joined the Blackburn Ai craft Company as works manager of the new factory.

At the same time comes the news that Mr. H. J. Stiege who, as chief designer to General Aircraft, Ltd., was respo sible for the Monospar, has joined Blackburn Aircraft, Ltd., t assist Major Bumpus, chief engineer.

A UNIQUE SOUVENIR. This £1 note, autographed by the late Sir John Alcock and Sir Arthur Whitten Brown, of pioneer Transatlantic fame, has been presented by the Managing Editor of *Flight* for auction at "The Merry Market," which is being held at the Royal Horticultural Hall, London, on November 18 and 19, in aid of the Great Ormond Street Hospital for Sick Children. The note was carried on the memorable flight.

Private Flying

Topics of the Day

Left and Right

THE appearance of such a comparatively large number of cabin machines in which the throttle and altitude controls are placed in the centre so that they can be reached by either the pilot or co-pilot, possibly means that yet another feature must be added to the instructional curriculum for more earnest pilots. They must learn to fly with either hand.

As one of those unfortunates whose left hand never knows what his right hand is doing, I eye such machines balefully and always fly them from the right side unless I am going up alone. Everybody who has learnt to fly *can* fly with the left hand, but the movements have none of that automatic co-ordination between eyes, hands and feet which is so essential when landing a strange machine on a bumpy day.

For some reason—possibly connected with unformed habit—I have never had any difficulty when flying with a wheel or spectacles with my left hand, but a stick seems all wrong, and it isn't possible to do much practising in any machine with the throttle on the left. Hence my instructional suggestion; the long-suffering teacher can do any necessary work with the throttle while the pupil tries to make his left hand do everything as well as his itching right hand will let him.

Trained Ambidexterity

QUITE a few pilots, of course, are naturally ambidextrous, and they consider themselves even luckier than the naturally left-handed pilot who has been forced to learn to use his right hand. My left-handed flying is coarse but mechanically accurate until I have to lift a wing during the hold-off or make a decent vertical turn.

Which reminds me of the left-handed pilot of a Liberty Nine who, after an unexpected bounce, had to galvanise himself into new life, change hands, open the throttle, flip the second ignition switch and wind the tail-wheel like mad. We have similarly happy moments with a central throttle and a row of left-side gadgets.

Incidentally, the side-by-side machine has one advantage during tuition which had not originally occurred to me. The instructor can *see* what his pupil is doing. All by yourself in the cockpit of a Moth or Cadet you may be busily flying with your heels on the rudder-bar, grasping the stick as if it was liable to jump out of your hands, or even, if you're naturally left-handed, holding it with the easy hand, leaving the throttle to itself. And all the time the instructor is wondering why you're ten minutes late every time in using the throttle after a bounce, or why he has to work so hard to take the controls over at a moment when there really isn't time to say very much. In the side-by-side trainer he can see the strained expression on your face—and you can see the pained expression on his.

This "B" Licence

SINCE grumbling a few weeks ago about the odd way in which the unfortunate "B" licence aspirants are tested in fits and starts by different people, I have heard of yet another trouble.

Apparently the instructors of No. 24 at Hendon have their own ideas about the right speed at which to make a rumble approach, and one or two otherwise efficient pilots have been turned down on this test because they had been taught to do them at 65 m.p.h. in a Tiger, while the tester has demanded a 55-m.p.h. approach—which is a very different matter indeed. Apparently the club and school chiefs have not been notified before any change in Hendon's idea of what a rumbling approach should be. Probably, in proportion to the actual stalling speed, 50 or 55 m.p.h. is a more useful speed, but that is neither here nor there.

"B" licence tests are done or observed by so many different people at present that it can be considered as something of a miracle that pilots manage to pass them at all. Furthermore, the "three light and three loaded" endorsement tests demanded for new types are not always observed and, sometimes, are not even done at all. So that we have the pleasant thought of Mr. A. taking a host of well-fed passengers to Timbuctoo in a machine which he has never previously flown with a full load.

Nowadays, with so many pilots going through these tests, the time has surely come for the development of a special Air Ministry section, comprising the necessary machines and ground staff, with, for instance, three well-paid civilian instructors for whom "B" licence testing is a full-time occupation. These instructors would be in continuously close touch with the transport operators and would, with the G.A.P.A.N., be in a position to make any necessary modifications to the curriculum—with due notice to all concerned. At present the very wheels of government need to be stopped before any change can be made—and the wheels grind ever so slowly, if exceeding small.

Car-engined Flying

AFTER this page had gone to press last week I recollected another automobile-engined machine which I had overlooked when remarking that the Ford was the only car engine to be successfully converted for aeroplane use. This other machine is the American Fahlin, which is fitted with a Plymouth engine, and in the course of a very interesting letter supporting the use of car engines in aircraft, Mr. Wikner also mentions my omission.

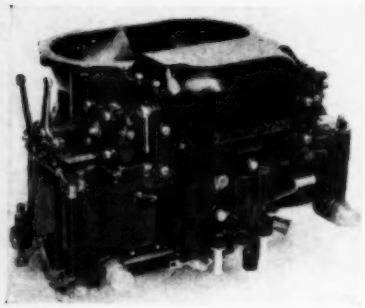
In a special issue of the kind in which these particular notes appear certain features must necessarily be curtailed in order that the whole industry shall be adequately dealt with, but the Editor tells me that he hopes to publish this letter in due course.

INDICATOR.

ACCESSORIES, COMPONE

A Review of the Activities of Over Where to Obtain Anything

FOR easy reference, each of the 230 firms dealt with in be found an index to the various components, etc., and firm or firms marketing that item. A second index their names. Though an attempt has been made to considerations of space make it impossible to detail every headings as "Parts, A.G.S., and General." Insurance dealt with in detail, but with



An example of the Hobson master control carburetter.

1 H. M. HOBSON (AIRCRAFT AND MOTOR COMPONENTS, LTD., 47-55, The Vale, Acton, London, W.3. So universal is the employment of Hobson carburation systems on British aircraft that few people should need reminding of the existence of such famous devices as the Hobson automatic boost control and automatic mixture control. There is also the Hobson master control carburetter, in which the mixture control and boost control are built integrally, together with the necessary linkage. This scheme, in conjunction with the Hobson pilot's cockpit control, makes it impossible for the pilot so to mishandle his cockpit levers as to give incorrect mixture strength or to damage his engine in any way.

Other Hobson specialities—which, incidentally, will be exhibited at the forthcoming Paris Aero Show, in common with the items listed above—include compressed-air-operated fuel pumps, an electric ice detector and an alcohol de-icer.

2 MECHANISM, 6a, George Street, Croydon, Surrey.—No one who has had anything to do with night flying needs an introduction to the Mechanism Demec navigation lights, which are of extremely neat and compact design.

Many other accessories have recently been added to their range of products. Among them is a landing light for internal or external mounting, and an artificial horizon weighing only 1½lb. Another, illustrated opposite, is a clock weighing 6oz. and provided with a time-of-flight hand and seconds hand of full dial size. The most recent addition to the range is a pressure gauge made in various types.

3 THE LONDON AND MIDLAND STEEL SCAFFOLDING CO., LTD., St. Luke's Works, Old Hill, Staffs.—The aircraft industry, and firms building hangars, have found a considerable number of uses for the products of this company. The basic principle of this particular steel scaffolding system is the "Quikgrip" double coupler, which makes for very speedy erection and dismantling. Tubular steel storage racks are one of the many industrial purposes for which this scaffolding is being used.

4 HENRY HUGHES AND SON, LTD., New North Road, Barkingside, Ilford, Essex.—Instrument and air navigation equipment is the speciality of this firm, and the Husun aperiodic compass needs no introduction to pilots.

For some time the firm has been working on a simplified system of navigation, in conjunction with Cdr. P. V. H. Weems of the U.S. Navy, and its principles are to be set out in book form.

Among the items which the firm supplies may be mentioned compasses, drift indicators, chart boards, Dalton computers, Waghorn protractors, C.D.C.s, direction gyros, gyro horizons and turn-and-bank indicators. In addition to these dead-reckoning instruments there is an amazingly extensive range of celestial navigation equipment.

5 A.C.-SPHINX SPARKING PLUG CO., LTD., Dunstable, Beds.—In addition to its aircraft sparking plugs, which are made in a wide range to meet all requirements, this well-known firm manufactures the following accessories for aircraft: Air cleaners and silencers, clocks, engine revolution indicators, fuel pumps, oil filters, oil pressure and temperature gauges, water temperature gauges and fuel gauges.

The firm makes a speciality of meeting constructors' requirements for the installation of these items.

6 THE HOYT METAL COMPANY OF GREAT BRITAIN, LTD., Putney, London, S.W.15.—Hoyt "Number Eleven" bearing metal is being extensively used in the aircraft industry. It has a number of qualities which recommend it strongly for aero engine work, among these being its extreme toughness and resistance to pounding and heavy loads, though these qualities involve no sacrifice of the anti-friction characteristics, which are of a high order.

Hoyt bearing metal has been used in the engines which have figured in a number of recent flying achievements, including C. W. A. Scott's Australia Race victory, the flights of Mrs. Markham and Miss Batten, and Sqn. Ldr. Swain's altitude flight. Every machine entered in this year's King's Cup Race had engine bearings lined with this product.

7 HELLIWELLS, LTD., Dudley, Worcestershire.—This firm is now concentrating on the manufacture of aircraft parts and, as related on page 469 of last week's issue of *Flight*, is in a position to manufacture a variety of intricate articles to A.I.D. limits. Work at present in hand includes windscreens and complete cabin enclosures, fuel tanks and other parts necessitating the use of sheet metal.

8 THOMAS GREEN AND SON, LTD., New Surrey Works, Southwark Street, London, S.E.1.—This old-established firm of lawn mower manufacturers includes in its range of machines several types of triple, quintuple, and septuple gang mowers, particularly suitable for aerodrome maintenance, where quick and efficient mowing is a primary consideration. The firm has fulfilled a number of Air Ministry contracts.

9 A. AND A. J. LAW, LTD., 132, Kingston Road, Merton, London, S.W.19.—Specialists in constructional steelwork, the company has erected a number of aeroplane hangars, some of very large size.

In addition to their activities in this direction, A. and A. J. Law are now in a position to undertake the construction of large-span buildings in timber while the present slow deliveries of steel persists. The designs include stout timber trusses, not to be confused with the light type commonly employed in buildings of this kind. It is claimed that heavy timbers in roof work are more fire-resisting than steel, since fierce fire will cause speedy collapse of a steel roof, whereas timber has to be actually burnt through before collapsing.

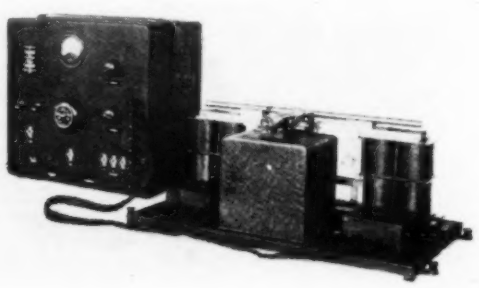
10 D. LEWIS, LTD., 124, Great Portland Street, London, W.1.—Among the extensive range of aviation clothing marketed by these specialists, the new combination flying suit may be singled out for special mention. Every detail making for extra comfort has been carefully studied. A heavy duty Zipp front, backed by a waterproof flap, extends from the right thigh to the tip of the collar; this not only makes it very easy to get into or out of the suit, but also extends the very deep collar up to the nose. The back belt is fully adjustable, while the two Zipp breast pockets and flap shin pockets are very deep and easy of access. With an exterior cover of fine quality heavy proofed gaberdine, this suit is lined with warm super wool fleece.

11 BENDIX, LTD., Tyseley, Birmingham.—From the earliest days of the adoption of aircraft braking systems this firm has been interested in their manufacture. Two types are made, one being a cable-operated pattern of light and simple design, and the other, more recently introduced, of the pneumatic type. There is nothing elementary about the cable-operated system, since full differential control is employed. Actually, either a cable or conduit system or cable and pulleys can be employed. The brakes are of the two-shoe servo type.

The pneumatic system was fully described in *Flight* of October 29. Again, it has servo operation and, of course, differential control, and there are a number of practical features.

12 THE AUTOMOTIVE ENGINEERING CO., LTD., 104, The Green, Twickenham, Middlesex.—A small but useful accessory made by this firm is the Seeger Circlip, for inside or outside employment in a number of situations. It was illustrated on page 386 of *Flight* October 15. It is made in a large variety of sizes.

13 LIGHTNING FASTENERS, LTD., Kynoch Works, Witton, Birmingham.—The chief use of Zipp fasteners on aircraft



The Salford Electrical Instrument Company's electro-magnetic fatigue tester. (23)

NTS and GENERAL WORK

200 *Firms in the Aircraft Industry : from a Split-pin to a Hangar*

this section has been given a number. On page 535 will after each item will be found the reference numbers of the on page 535 provides direct reference to firms under make the accessories index as comprehensive as possible, type of small part, and reference should be made to such companies and technical training schools have not been to found listed on page 534.

is for opening and closing inspection vents. Air Ministry regulations stipulate a regular inspection which usually involves breaking through the doped fabric; it is obviously much easier to open a Zipp fastener. The usual form of vent is in one of three shapes.

The first is made by two long Zipps, forming a triangular flap; another is a circle for which curved "Lightning" fasteners are supplied and the third is formed by one length of Zipp, partly curved and partly straight, which gives a really large flap. The Lightning Zipp supplied for such purposes can be had with a slider operated from either side. The use of this fastener in aviation suits is so normal as to be hardly worth mentioning.

14 HERBERT TERRY AND SONS, LTD., Redditch.—As steel spring specialists, this firm has been recognised during the past ten years or more for its development of valve springs for high-efficiency engines. Of the many interesting tests applied one of the most stringent is to uncoil a completed valve spring into a straight wire, which is then twisted between the grips of a torsion-testing machine. At least twenty turns are usually required to break the wire, which twists uniformly throughout its length, despite the fact that it has previously been coiled.

15 TANNOY PRODUCTS, Canterbury Grove, West Norwood, London, S.E.27.—Loud-speaker equipment has very many uses at the modern terminal airport and at aerodromes where flying meetings are being held. Tannoy equipment can also be installed on a "call" system whereby any member of the staff can be found in a few seconds.

Standard outputs of a range of 8 to 200 watts are available and special projection horn-type loud speakers can be used for outdoor work. For indoor work, box baffles or baffle-type speakers are used.

16 TURNER'S MOTOR MANUFACTURING CO., LTD., of Moorfield Road, Wolverhampton, have for some time been producing a patented compressed-air landing leg for use on heavy and light aircraft. A range of designs has been made to meet all requirements of the aircraft industry, and a number of leading aircraft are now fitted with these components. A similar type of landing leg working on the oil-plus-air principle is produced by the Turner Company. Oil is used for absorbing the landing shock, whilst air is used for taxiing. This system is used where energy absorption requirements are high, and where small strokes have to be incorporated.

In addition, this company has the sole British manufacturing rights for the Heinkel compressed-air type of undercarriage, and for the American Romec fuel and vacuum pumps.

17 JAMES WALKER AND CO., LTD., "Lion" Works, Woking, Surrey.—In this company's range of special packings and jointings, probably Gaskoid, which is impervious to the action of oil and petrol, is the most important. Walker's have a completely equipped plant for the manufacture of Gaskoid, and for dealing promptly with every description of gasket work.

Other items of interest from these works include Golden Walkerite compressed asbestos jointing; Copandas, which are metal-sheathed joints filled with strong asbestos material; Lion water-pump gland rings; and Sentinel oil and spirit jointing for diesel-type engines.

18 C. C. WAKEFIELD AND CO., LTD., Cheapside, London, E.C.2.—It might be expected that pilots on speed record or endurance flights would pay special attention to the selection of an engine oil. The fact that Patent Castrol has figured in so many such flights, including, most recently, Miss Jean Batten's flight to New Zealand last month, is something of a tribute to its reliability. In this lubricant sludge and corrosion resistance properties are, it is claimed, provided by the incorporation of soluble compounds of tin and chromium.

19 WELLWORTHY PISTON RINGS, LTD., 89, Blackfriars Rd., London, S.E.1.—It has often been suggested that piston rings still form the weakest link of the many component parts of an aero engine since their duties, particularly in air-cooled engines, are most severe. Standard material is not really good enough, and that with which the Wellworthy firm has had the greatest success is Thermocrom (to DTD.233 specification), which has not only shown a reduction of loss of tension, due to heat and other causes, but has also proved to be more resistant to "hammering."

20 THE WEYBURN ENGINEERING CO., LTD., of Elstead, Surrey, manufacture a comprehensive range of engine components for the aircraft industry, their chief products being camshafts, gudgeon pins, tappets, airscrew bosses, unit assemblies, and any parts requiring a great degree of accuracy, both in machining and heat treatment.

21 THE WILLIAMSON MFG. CO., LTD., of Willesden Green, London, N.W.10, produce a range of aircraft cameras which may be sub-divided into two categories; survey cameras for military and civil purposes, and camera guns for aerial gunnery training. Of the survey cameras, the Eagle III and IV can be used unmodified with or without instrument records. Both are fitted with the Williamson all-metal louvre shutter and can be operated either manually or automatically by mechanical or electrical controls placed at a distance from the camera. These cameras

This aeroplane clock is made by Mechanism, Croydon. (2)

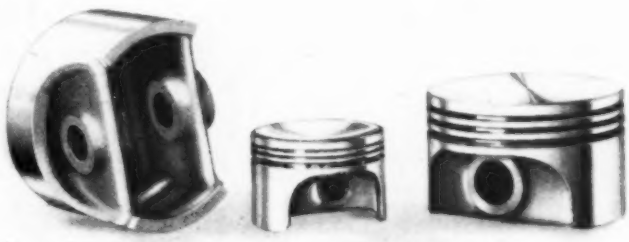
are designed to accommodate a supply of film sufficient for making a large number of exposures without reloading, but magazines are easily interchangeable in the air.

The Williamson single-picture camera gun (G.22) is designed in two forms, for use by a pilot and for use by an observer, while the Williamson ciné camera gun has been produced in order to satisfy those who consider that a cinematograph record of an aerial combat is better than that given by the single picture camera.

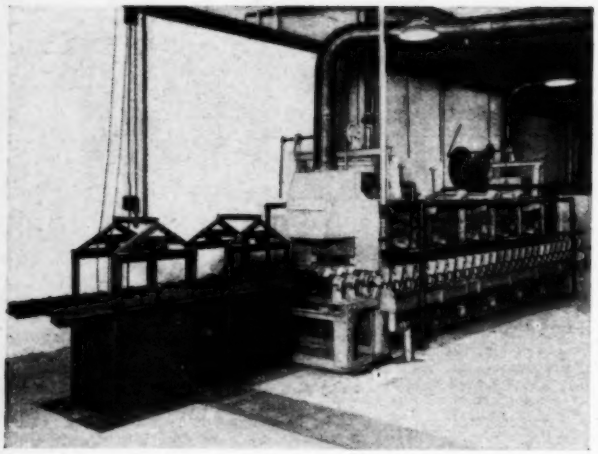
22 LLEWELLYN RYLAND, LTD., of Balsall Heath, Birmingham, 12, was established as a firm nearly a century and a half ago and still remains a private company under the direct control of descendants of the founder. Amongst their aircraft specialities is Ryland varnish and enamel, primarily for the protection of seaplanes.

One of their latest products is Duralac jointing compound. The satisfactory filling of lapped joints and seams of all-metal seaplane hulls and floats has presented a problem of considerable difficulty. In Duralac, the firm claims to have solved this problem. The hull of a Short Rangoon flying boat, recently examined, was found to be in a watertight condition after six and a half years' service. Duralac is a plastic material which may be easily applied by means of a brush; is waterproof, non-corrosive, and remains elastic almost indefinitely. Another speciality product is Olasto lacquer for the internal protection of water tanks, and the firm manufactures a complete range of various materials required by the industry, including Ardak for cadmium-plated steel engine parts.

23 SALFORD ELECTRICAL INSTRUMENTS, LTD., Peel Works, Silk St., Salford, 3.—This firm's electro-magnetic fatigue tester, which was originally conceived by the G.E.C. research laboratories and has been on the market for some time, has now been completely redesigned as a result of experience gained. The same principle is employed, namely, that of vibrating a test-rod or bar electro-magnetically at its natural frequency so that a high rate of impulse is obtained. A complete test can thus be performed in a few hours.



Three types of Specialloid aero piston. (28)



A gas-fired refractory roller hearth furnace for general heat treatment of forgings, by the Incandescent Heat Co. (38.)

The improved model comprises a mains unit and a vibrator, but each part has been redesigned for improved performance and greater scope. A new type of tuned relay is used both to trip the gear on failure of the specimen, and also, by means of its calibration, to indicate directly the frequency of vibration.

The firm's logarithmic time base recorder was designed primarily for use with the fatigue tester so as to indicate failure. This is particularly valuable when a number of vibrations are used with similar test-rods, each being operated at a different stress.

24 STANDARD TELEPHONES AND CABLES, LTD., Connaught House, Aldwych, London, W.C.2.—The needs of airport and operator in the matter of radio equipment are many, and it is only possible to mention a few of the more important examples of equipment by this firm. One of the more interesting developments is a short-wave ground station comprising a 200-watt type R.4 transmitter providing any of four preset frequency settings, and an 8-valve type R.5 superheterodyne receiver. When a machine carries a radio operator, a typical set consists of a type R.2 transmitter giving two ranges, and a superheterodyne receiver covering the same frequency band. For pilots' use another set (type R.9) provides a rapid change of preset frequencies; a simple receiver suitable for all services between 261 and 545 kc is provided.

The Standard-Adcock direction-finding system is now well known and is claimed to provide D/F accuracy within ± 2 per cent. under all conditions. A special lightweight type of D/F receiver and "homing" set for aircraft use has a hand-operated loop and provides both visual and aural indication, while the R.5 automatic radio compass is specially suitable for really accurate work. Examples of each of these pieces of equipment are being exhibited at the Paris Show.

25 SHELL-MEX AND B.P., LTD., Victoria Embankment, London, W.C.2.—Of the successes recently obtained by Shell products, most important, perhaps, was the world's altitude record of 49,967 ft. on which Shell fuel and oil was used. Fuel was also supplied for both Miss Jean Batten's and Mr. James Mollison's flights.

Shell aviation oils and fuels are available on demand on aerodromes throughout the world, and in any Shell main office a pilot can be informed which commodities may be obtained immediately at any aerodrome, or what notice is required at rarely visited landing grounds, to ensure that there is no delay. This service has been well established for a long time, and the organisation for supplying these products has, times without number, been called upon by pilots possessing an "open sesame" of air touring—the Shell Carnet.

26 JOHN SHORT, LTD., Mousehold Aerodrome, Norwich.—Since the company was registered in March this year its newly equipped sheet-metal shop has specialised in producing built-up components for the Fleet Air Arm. It undertakes all types of sheet-metal work and it operates the largest Anodic oxidisation plant in East Anglia. In addition to satisfying its own requirements, treatment of the products of other firms is undertaken.

The company's name is on the Air Ministry list of gauge manufacturers, and the equipment of the machine shop has recently been augmented by the addition of a number of precision machines of the latest type. A tracing department was recently established and tracings from original drawings are produced in large numbers for those firms whose tracing sections are overtaxed. Plans for the manufacture of such components as wings, ailerons, rudders, tail planes and flaps will shortly be completed, and the company has secured large additional floor space eminently suitable for such work.

27 SKEFKO BALL BEARING CO., LTD., Luton.—In general it may be said that bearings from the S.K.F. standard ranges meet all the requirements of the aircraft industry, but there are cases where specially designed bearings are necessary and the firm's policy is to develop such types as and when the demand is sufficient.

For normal aircraft purposes the double-row self-aligning extra small type bearing has been very widely used. The self-aligning feature is most valuable in accommodating the slight distortion which inevitably occurs in the structure. The single-row, deep-groove type is in favour for such applications as landing wheels or airscrew thrusts. Cylindrical roller bearings have higher load-carrying capacity than ball bearings of the same overall dimensions, and are used as main crankshaft bearings in certain aero engines, while taper roller bearings are used in landing wheels where high thrust loads may be encountered.

The spherical roller bearing is primarily intended for very heavy work, but it has given very successful results as a thrust unit for airscrews of large engines.

28 SPECIALLOID, LTD., of Friern Park, North Finchley, London, N.12, will manufacture their pistons either to customers' drawings or to recommended Specialloid designs. The alloys used are compounded in their foundry and the rough machined castings are heat-treated in accurately controlled electrical muffles, especially designed for low-temperature treatment of non-ferrous alloys. The machining and all the manufacturing processes are under the careful supervision of A.I.D. inspectors, and the firm is on the Air Ministry list and are piston suppliers to several of the leading aero engine factories.

29 HEPWORTH AND GRANDAGE, LTD., Bradford.—Vacrit cast iron is very well known in the automobile industry and is extensively used for cylinder liners and so on. Hepworth and Grandage have now turned to the aircraft industry, and after a long period of metallurgical research have produced "Aero Vacrit" cast iron for piston rings which have to work under severe conditions as in aero engines. Extended trials in various types of aero engines over the past two years have fully justified the claims made.

"Aero Vacrit" is not heat-treated, the rings being supplied in the as-cast condition. The Vickers hardness is 250/275, but the structure of the material is controlled to give a perfect oil-retaining bearing surface.

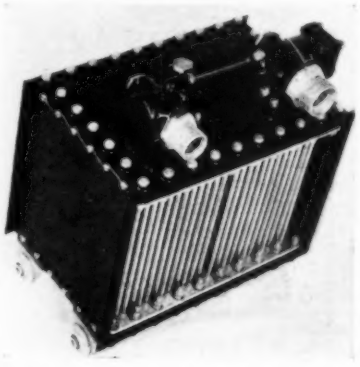
Pistons are being supplied in all aluminium alloys, both sand-cast and forged.

30 BELL'S ASBESTOS AND ENGINEERING SUPPLIES, LTD., Bestobell Works, Slough, Bucks.—Suits of asbestos for use both by pilots and by aerodrome ground staff in emergencies are annually receiving greater attention. The heavy suits designed for aerodrome work, clad in which a man can withstand temperatures up to 1,700 degrees F., and walk in and out of the fiercest blaze without harm, have been taken up by many British aerodrome authorities. When machines catch fire on the ground and are ordinarily unapproachable, rescue and salvage workers can carry out their work in safety by means of the asbestos fire suit. A lighter form of the clothing, in general appearance resembling a suit of overalls, is also available for pilots.

These suits, and other asbestos articles, including shields for use in approaching fires, drop curtains which in passages and corridors will check the progress of flames, and movable screens to isolate the scene of the blaze, are manufactured by Bell's Asbestos and Engineering Supplies, Ltd., as are the asbestos gloves now compulsory in Service aerodrome equipment.

31 B.E.N. PATENTS, LTD., Gorst Road, Park Royal, London, N.W.10.—Products of this firm applicable to the British aircraft industry embrace paint- and dope-spraying machines and equipment, among which the portable "Pneu-Spray" machine is very popular. It can be supplied with electric motor or petrol engine drive and is particularly suitable for aircraft doping purposes. Other suitable machines are the P.10 and "Pneu-Matic" 12 and 20 machines for working two or more spray guns.

There is a spray gun specially designed for handling dopes and synthetic finishes as well as paints, lacquers, varnishes, etc., with maximum speed of coverage. This model is known as the "R.F." gun, and a round or fan spray can be obtained by a simple adjustment of the spray head.



Robertson oil cooler for the Napier Rapier engines of the Mayo-Composite aircraft. (85.)

32 BAKELITE LIMITED, 68, Victoria Street, London, S.W.1.—On the new Short Empire flying boats "Trefoil" Bakelite laminated sheet material has been used throughout the craft for electrical insulation purposes. Another development of outstanding interest is the use by Dr. de Bruyne of Bakelite materials for the blades of the variable pitch airscrew which was shown recently at the opening of the Aerial Research, Ltd., laboratories at Cambridge. "Trefoil" Bakelite laminated sheet is also being used for instrument panels, and mouldings made from this material are used for components too numerous to detail.

33 THE LOCKHEED HYDRAULIC BRAKE CO., Leamington Spa, Warwickshire, have recently made large extensions to their factories, which are equipped with the very latest machine tool plant for producing extremely high-quality hydraulically operated aeroplane components.

In conjunction with the Fairey Aviation Co., Sir W. G. Armstrong Whitworth, Ltd., and other manufacturers, these have been standardised on aircraft ordered by the Air Ministry under their expansion programme, whilst numerous other firms are incorporating them in their prototype machines.

A typical Lockheed installation, as applied, for instance, to a famous bomber, consists of complete hydraulic operation of retractable undercarriage, wing flaps, and bomb hoists, hydraulic actuation being obtained through an engine-driven fluid pump, or, alternatively, through a hand pump for emergency purposes. The various components are selected through a centralised control.

34 AMAL, LTD., Perry Barr, Birmingham.—Amal fuel pumps are made as single or as double units, where one pump feeds the engine and the other pump is in reserve.

Each pump has a priming lever, which can be operated to prime the engine no matter in what position the operating cam may be.

Another Amal speciality is the flame trap for carburetter intakes; in case of backfire the pressure is liberated, but the flame is cooled out. The flame trap may also be used as a tank filler protector.

Thirdly, thermometer oil pockets are made to house a thermometer for reading oil temperatures.

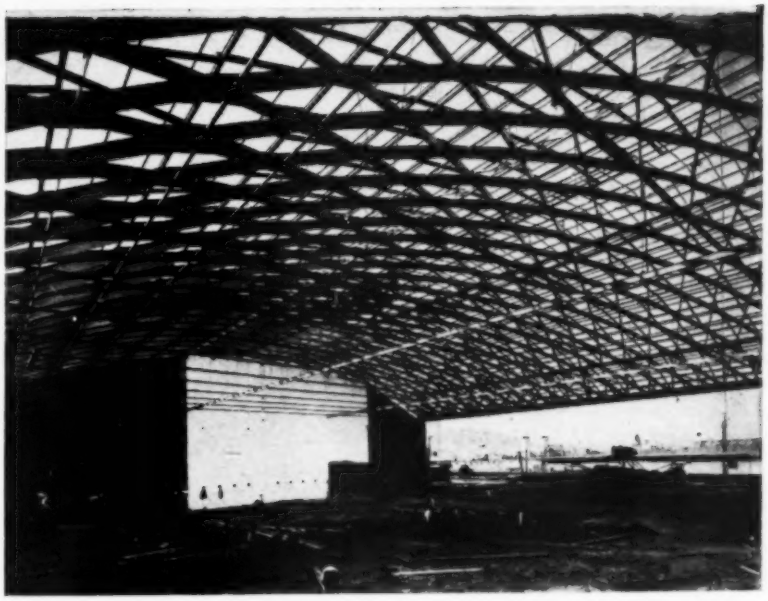
Amal ball and roller joints are used for all aircraft secondary non-flying controls. The ball type is self-locking with a micrometer adjustment to take up any wear.

Other specialities of this old-established firm include test-bench fuel flowmeters and also jet calibrating machines.

35 AIRCO LIMITED, 3, St. James's Square, London, S.W.1.—This company's activities cover the supply of all types of flying clothing, maps, books (including Air Ministry publications), navigation instruments, aircraft spares and equipment, aircraft materials, aerodrome and workshop equipment, etc.

They are also the sole agents for the British Isles for the aerodrome lighting equipment manufactured by Clarke, Chapman and Co., Ltd., and for the T.I. screening harness described in Flight of October 8. They are sole British Empire agents, too, for Interavia and Interavia A.B.C.

36 AIRCRAFT COMPONENTS, LTD., Arle Court, Cheltenham.—This firm's display at the Paris Show will be typical of their products. They will exhibit a complete stub wing demonstrating their sideways retracting undercarriage operated by the "Dowty patent nutcracker" struts and engine-driven hydraulic pump, and also a large panel to demonstrate a backwardly retracting undercarriage, a retracting tail wheel and hydraulically operated flaps. All these units are operated from an engine-driven pump. The well-known single lever control developed by this Company is used to control movement of flaps, undercarriage and tail wheel.



A Lamella hangar roof by Horseley Bridge and Thos. Piggott, Ltd. (40).

Other products to be shown include wheel and flap indicator operated by Simmonds-Corsey control cables. Red and green lights indicate the locked "up" and locked "down" positions of the undercarriage and tail wheel. A buzzer is interconnected with the throttle control.

Dowty internally sprung wheels will be shown. One exhibit is mounted on a cantilever leg, and a second is shown dismantled. Various smaller units include standard tail-wheel shock absorbers—which are fully castoring but return to their fore and aft position in flight—and oleo-pneumatic shock absorbers.

37 AERONAUTICAL AND PANEL PLYWOOD CO., LTD., 218/226, Kingsland Road, London, E.2.—Canadian birch is usually used for the construction of aeronautical plywood to B.S.I. Specification 4.V.3, the veneers being cut in this country from logs imported direct from Canada. Various types of adhesive are used for gluing the plies together, but for hot and tropical countries this firm now employs a synthetic resin type of adhesive which is heat and water-resisting and impervious to fungus growth and bacteriological attack.

Other types of aircraft plywood are sheets made up with a double thickness core and with the grain of the outer plies running at an angle of 45 degrees, which greatly adds to the strength, particularly for highly stressed parts.

They are also producing a special type known as "Balsaply," which is built up with a Balsa core reinforced with two thin veneers of Canadian birch on each side, the effect being a combination of extreme lightness, together with rigidity and strength.

In addition to the above, Aeronautical and Panel Plywood produce shaped sections for leading edges and also complete fuselage sections scarf-jointed to lengths and cut to shape ready for fixing.

38 THE INCANDESCENT HEAT CO., LTD., Cornwall Road, Smethwick, Birmingham, are specialists in the design and manufacture of all types of industrial furnaces and equipment. The range covers gas, oil, electric, producer gas and coal-fired furnaces, together with charging machines, quenching plants, conveyors, gas producers, drying plants, melting and liquid bath furnaces, mechanical equipment, mill gear, pyrometers, automatic controllers, etc.

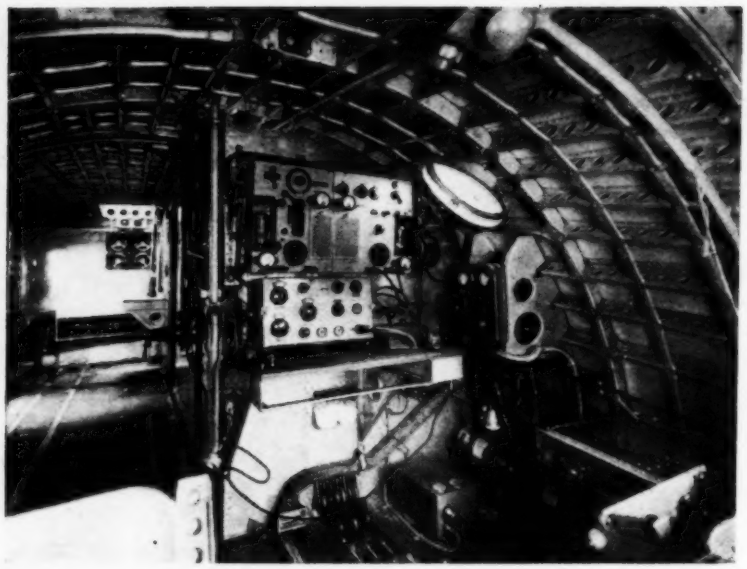
39 HUNTERS OF CHESTER (JAMES HUNTER, LTD.), Chester, aerodrome constructors, are the inventors of the process known as "Hunterising," which produces level, solidly compact, self-draining surfaces. They possess a staff of specially trained and highly skilled workmen, and a battery of soil-excavating, levelling, grading and transporting implements, which, it is stated, is notable for perfection of performance and magnitude of scope.

40 HORSELEY BRIDGE AND THOMAS PIGGOTT, LTD., Tipton, Staffs.—This firm's "Lamella" hangar construction provides a clear and uninterrupted floor space. Provision is made for future extension and unit construction lends itself to easy transport and speedy erection, mainly by unskilled labour.

"Lamella" construction is essentially rigid: the shape of the pressed-steel section is developed to obtain the maximum rigidity. The whole structure is built on the sound principle of the arch, and its strength is exceptional for the weight of steel employed. The units are light in weight and nest together compactly for ease and economy in transport. It is claimed that pressed-steel construction speeds up erection and reduces labour costs.

41 THE HOFFMANN MANUFACTURING CO., LTD., Chelmsford, Essex.—Hoffmann ball and roller bearings are well known and widely used in the aircraft industry. The range embraces bearings for every aviation need; and in order to render it as complete as possible two new series have recently been placed on the market, specially adapted for aeroplane controls. These are known as the "C.S." and the "T" types, the former being journal bearings fitted with side shields and having their exposed surfaces cadmium plated, and the latter being bearings of light section in convenient sizes for mounting on torque tubes.

For six consecutive years, it is stated, every engine entering for the King's Cup Air Race has used Hoffmann bearings, and they



Marconi transmitter, receiver and D/F equipment in *Canopus*. (65)

have figured in many recent record-breaking flights.

42 HIGH DUTY ALLOYS, LTD., Slough, Bucks, are manufacturers of the "Hiduminium" R.R. alloys. The parts produced in either die-cast or wrought forms are numerous, but outstanding are cylinder heads, cylinder blocks, pistons, crank cases, reduction gear cases, impellers and connecting-rods. Typical of these is the crank case stamping in R.R.56 for the Bristol Pegasus engine.

The alloys are used as castings, stampings or extruded sections in the construction of the majority of the new types of military aircraft. The Empire flying boats use a considerable quantity of R.R.56 in the form of extrusions. "Hiduminium" alloys have always been connected with metal airscrews, and recent developments have proved no exception, the blade stampings supplied for the D.H. controllable-pitch airscrew assemblies being produced in R.R.56.

The associated company, Magnesium Castings and Products, Ltd., manufacture the "Magnuminium" series of magnesium-base alloys in all cast and wrought forms to the respective Air Ministry specifications.

43 THOS. P. HEADLAND, LTD., Pearman Street, Westminster Bridge Road, London, S.E.1, are Air Ministry approved stockists for aircraft steels and A.G.S. parts, and comprehensive stocks are held ready for immediate release. They are also British Empire agents for the DZUS self-locking cowling fastener. This is a rigid, simple and permanent fastener, and is being increasingly used.

Among their other work, they are specialists in machine shop, fitting shop and aerodrome tools and equipment, including transmission gearing, etc., and are sole London stockists for the English Steel Corporation's tools, steels, etc.

44 HAWKES AND SNOW, LTD., Shirley, Birmingham.—The "Eclair" balancing door has extensive application to aircraft hangars, and the makers are busy with important orders. Roughly speaking, this type of door pivots about horizontal centres, and a special device ensures that it goes up flush with the lintel when fully opened.

Hawkes and Snow have recently completed such a door 150 ft. wide and 40 ft. high, in one piece, and so perfectly balanced is it that it can be manually operated by two men, although the actual weight of the door itself is of the order of 60 tons, and the total weight of door and fittings is in the nature of 150 tons.

Further, the time of opening is roughly two minutes, and, of course, there is no possibility of the door jamming at any time, as its lifting motion when opening clears any obstruction.

The door is fitted as an independent unit, takes its own wind pressure, and passes on to the building no stresses of any kind, as it is not connected to it in any way whatsoever.

45 LACY-HULBERT AND CO., LTD., Boreas Works, Beddington, Croydon, Surrey.—One of the specialities of this firm is an automatically controlled, direct-driven air compressor plant for centralised compressed air supply for aerodromes, aircraft factories, etc.

Similar plants are supplied for the operation of pneumatic tools, spraying paint, tyre inflation, and many other uses. These are made in sizes varying from 2½ cu. ft. to 400 cu. ft. of free air per minute.

Apart from these stationary units, the makers supply portable compressor plants, both electric and petrol-driven, for use in the aircraft industry.

46 JOHN HALL AND SONS (BRISTOL AND LONDON), LTD., Broadmead, Bristol, 1, are fully approved by the Air Ministry as manufacturers of aircraft dopes, cellulose lacquers, synthetic enamels, oil paints, stoving enamels and varnishes, etc. They are specialists in the manufacture of protective materials for use on alloy surfaces, particularly magnesium and chromated alloys, and, incidentally, are responsible for the excellent and durable finishes on all Bristol engines.

They offer a clear priming lacquer that has exceptional adhesion on the most difficult surfaces, and an air-drying chromate primer for use on floats and hulls. Their special quick air-drying (1½ hours) synthetic lacquer, also, is used extensively by the Aircraft industry.

John Hall and Sons have given careful consideration to the problem of obtaining "super" finishes for aircraft and are in a position to recommend definite processes. They market their products under the proprietary names of "Diamond," "Procelloid," "Vestola," and "Brolac."

47 LLOYDS AND CO. (LETCHWORTH), LTD., Pennsylvania Works, Letchworth, Herts, are specialists in gang mowers for aerodrome work. Their machines are used by the Air Ministry, the Fairey Aviation Co., De Havilland Aircraft Co., the municipal airports at Portsmouth, Southampton and Bristol, and at Brooklands Flying School, Sywell Aerodrome, and others.

These machines are made of high tensile strength steel and malleable throughout, which permits them to stand up to the most strenuous conditions with the minimum of wear or breakages. The units are attached to the frame by universal joints which allow swivelling in any direction, thus automatically adjusting them to ground contours.

For many years Lloyds and Co. have had contracts with the Air Ministry for mowing aerodromes, and the machines they now manufacture are the result of the experience gained.

48 THE LEWIS SPRING CO., LTD., Resilient Works, Redditch, have for many years specialised in the manufacture of fine coil springs, spring pressework and wire work for aircraft use. As all their products are made to customers' specifications and drawings they do not issue a catalogue.

They number among their customers many of the leading aircraft manufacturers, of course, from the Air Ministry. Having their own A.I.D.-approved inspection department, they are able to give specialised service and are at all times pleased to offer their experience and knowledge in the designing of springs to perform any given mechanical operation.

An aerodrome apron surfaced with Colas. (70)

Indices to the equipment described in this section, and to the names of firms, will be found on page 535.

49 LAMINATED WOOD PRODUCTS, LTD., 109, Kingsway, London, W.C.2.—This firm states that it is supplying the well-known "Saro" plywood (manufactured by Saunders-Roe, Ltd.) to most of the leading aircraft concerns in this country, and is also exporting a certain amount of plywood of all thicknesses.

The wood is manufactured with a Bakelite type of cement which is fused on in a hot press at considerable pressure. It is manufactured in thicknesses from 0.5 mm. upwards three-ply, and 0.8 mm. upwards five-ply, and can be supplied in all reasonable sizes.

It is, of course, used for webs of spars and ribs, and also for covering wings and fuselage.

50 KURT ERLACH, LTD., 2, Melior Street, London, S.E.1.—The "Volspray" 1A/2 spraying outfit is of particular interest to the aircraft industry. Weighing under 30 lb. complete, and no bulkier than a gallon can, it operates a full-sized pistol. The totally enclosed ¾ h.p. compressor motor is wound for A.C. or D.C. current and can be used on a lighting circuit.

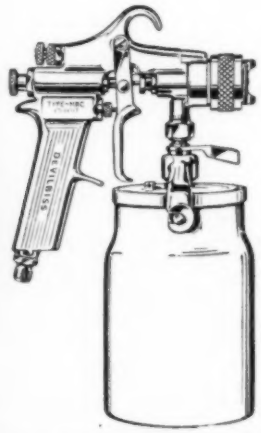
In common with all the maker's "Air Volume" type equipment, fog and fumes are reduced to a minimum, so that the operator works in more hygienic conditions and a considerable saving in paint is accomplished. Water condensation is entirely absent, which in tropical and sub-tropical climates is more than half the battle in spray painting.

It is stated that a great many manufacturers, airlines, air forces, flying clubs and private owners employ "Volspray" equipment for both production and/or maintenance work.

51 THE KORECT DEPTH GAUGE CO., LTD., Parliament Mansions, Victoria Street, London, S.W.1, specialises in instruments of the metallic membrane type such as air-speed indicators, pressure gauges and transmitter gauges, and have very recently put on the market a continuous reading depth gauge known as Nutsford MK.VIII.

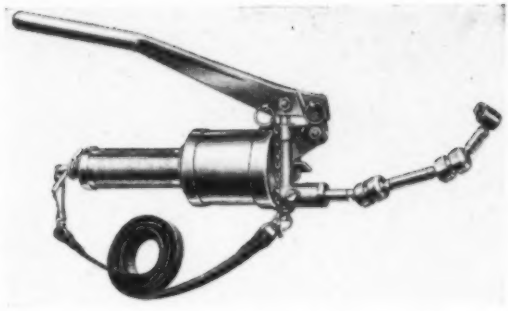
Associated with them is the Self-Priming Pump and Engineering Co., Ltd., who specialise in fuel pumps of the fabric diaphragm type. Their specialised products include a double diaphragm pump giving delivery up to 150 galls./hr., a single-diaphragm pump giving a delivery up to 50 galls./hr., and an emergency hand-operated diaphragm pump giving up to 30 galls./hr.

They also specialise in a petrol reducer valve which allows the fuel pump working in conjunction with it to give a pressure of 6/7 lb./sq. in. on one side of the valve and only 2/2½ lb./sq. in. on the carburetter side.



De Vilbiss Type M.B.C. spray gun, by the Lacy-Hulbert Co. (45)

A portable high-pressure greasing unit by Tecalemit. (74)



52 KAYSER, ELLISON AND CO., LTD., Carlisle Works, Sheffield, 1, are manufacturers of all types of special alloy steels used in aeroplane motors. Perhaps the best known of their special steels is K.E.965 heat-resisting steel for valves, probably more widely used for aero-engine valves than any other. It is standardised by such firms as Armstrong Siddeley, Bristol, De Havilland, Rolls-Royce, Cirrus-Hermes and British Salmson.

53 KALOROIL BURNERS, LTD., Hammond Works, Victoria Road, London, N.W.10.—The use of waste oil for firing boilers, whilst a new departure in oil burning, is, it is claimed, perfectly simple and satisfactory. The Kaloroil heavy oil burner operates on oil up to 200 in. viscosity and is of the fully automatic pressure jet type.

The Kaloroil portable burner is used for a large number of different purposes and can be used for night flares at aerodromes. It can be made with up to four burners on one machine, so that the flares can be arranged in any suitable form, such as single lines, double lines, arrows, and so on. The flares can be up to 12ft. in length. Kaloroil grass-drying machines, it is stated, are being installed at aerodromes for drying grass after cutting, this making it saleable as cattle food.

54 JOHNSON, MATTHEY AND CO., LIMITED, 73/82, Hatton Garden, London, E.C.1.—New uses are constantly being found for this firm's silver solders in a number of jobs where resistance to corrosion and vibration are of primary importance. Particularly outstanding is the popularity of the alloy known as "Sil-fos," which is now widely used in this country and overseas for making joints on copper, brass and bronze. Its chief advantages are quick and thorough penetration, the small amount of flux required, and the rapidity and ease with which it may be employed.

On account of their resistance to shock and corrosion, silver solders are being employed increasingly for such purposes as internal and external copper pipe connections on fuel and oil lines, in push-rod bushings, flanges, and connections of control wires and couples.

55 THE IRVING AIR CHUTE OF GREAT BRITAIN, LIMITED, Letchworth, Herts.—The wide range of parachutes makes it possible for this life-saving device to be used on any type of aircraft. The chair-type parachute, in which the pack can be placed under the seat or behind the back, as required, is incorporated in the upholstery so that nothing is showing except the two shoulder straps into which the shoulders are placed in emergency. Alternatively, this type can be used with the quick-release harness in a seat which has no upholstery.

Still another type which has a wide use is the quick-release, quick-connector parachute. Here the pack can be carried in any convenient place in the aircraft and instantly clipped on to the individual's harness when required in emergency.

Irving parachutes are extensively used by air forces at home and abroad.

56 NORTHERN ALUMINIUM CO., LTD., Bush House, Aldwych, London, W.C.2.—Outstanding among this company's alloys insofar as aircraft work is concerned are Alclad NA. 17ST to specification L.38 and Alclad NA. 24ST to specification DTD. 275.

These alloys combine maximum corrosion resistance with high strength, due to the fact that they have a high purity aluminium coating over the high strength alloy underneath, and they are being very widely used by aircraft firms at the present time, particularly for marine aircraft, boat and seaplane construction.

There is also extrusion alloy NA. 22ST to specification DTD. 252. This specification calls for the following physical characteristics:

Ultimate tensile stress ...	28 tons/sq. in.
0.1 per cent. proof stress ...	22 tons/sq. in.
Elongation on 2 in. ...	Not less than 8 per cent.

Again, there is alloy NA. 15ST, which conforms to specification DTD. 293, and has the following minimum properties:

Ultimate tensile stresss ...	27 tons/sq. in.
0.1 per cent. proof stress ...	21 tons/sq. in.
Minimum elongation on 2 in.	10 per cent.

In addition, of course, the company manufacture sheet alloys to specifications 4.L.3, and DTD. 270. On the castings side, they have developed special alloys for aircraft work, namely, NA. 225 to specification DTD. 298 and 304, and NA. 350 to specification DTD. 300. These are in addition to the older known alloys to specifications 4.L.11, 2.L.24, L.33, L.35, etc.

57 NORTHERN AIRCRAFT PRODUCTS, Jordan Street, Knott Mill, Manchester, 15.—This firm specialises in the construction of tanks, fairings, cowlings and containers of all types made from aluminium and its alloys. Recently, considerable work has been done in Elektron and they are in the middle of several contracts for the Avro Anson which necessitate the use of this material. Among Elektron items may be mentioned pilots' seats. The firm has its own self-contained anodising plant and is therefore in a position to manufacture complete items without having to send out of the factory. Fairing rings for radial engines are another instance of a recent contract, these being for Armstrong Siddeley Tiger engines, while the firm is well equipped for the production of exhaust pipes.

58 NOBEL CHEMICAL FINISHES, LTD. (Associated with Imperial Chemical Industries, Ltd.; Nobel House, Buckingham Gate, London, S.W.1), produce aircraft finishes, including cellulose doping schemes, lacquers and enamels, and "Dulux" synthetic air-drying and stoving enamels. They are also recognised authorities on the pre-treatment of metals prior to painting and have developed a range of products and processes to ensure the satisfactory adhesion of finishes to metal surfaces.

Among the products most generally required are A.C.P. "Lithoform" for the pre-treatment of galvanised iron, zinc and zinc base alloys in situ, and A.C.P. "Granodine" 31 for the pre-treatment of components of the same materials as well as for cadmium-plated surfaces in mass-production

The workshop hangar at Heston during its construction for Airwork Ltd.; the builders were Boulton and Paul (88).

work. The A.C.P. "Deoxidine" process for preparing and cleaning iron and steel surfaces prior to painting is extensively used. The A.C.P. "Cromodine" process for iron and steel surfaces retards rust creep by neutralising the active rusting agents should such metal surfaces be laid bare through a fracture of the paint film, while the A.C.P. Electro "Granodine" 30 process has recently been introduced for iron and steel pre-treatment.

59 THE NATIONAL FIRE PROTECTION CO., LTD., Richmond, Surrey, who are the designers and manufacturers of the "Essex" appliances, have produced, after five years of experiment, an entirely new device, having a capacity of half a gallon with a total weight of 11 lb. Capable of not only extinguishing fire in flight, but of preventing combustion spreading to burst tanks from the engine compartment, it is operated entirely automatically.

Actual tests carried out at the R.A.E. have shown that the claim to extinguish a fire in the engine, arising from a broken petrol pipe delivering three gallons per minute, has been proved. In the words of a high R.A.F. officer, "Any device capable of reducing the fire risk by only 10 per cent. is worth adopting." It is clear from examination of this new device that a 10 per cent. reduction will be greatly exceeded.

World sales arrangements for the new No. 4 "Essex" automatic aircraft device are in the hands of Smiths Aircraft Instruments of Cricklewood, London, N.W.2, who, incidentally, are at the Paris Show.

60 TRIPLEX SAFETY GLASS CO., LTD., 1, Albemarle Street, Piccadilly, London, W.1.—The new transparent resin in sheet form, known as Perspex, and produced by Mouldrite, Ltd., (a subsidiary company of I.C.I.) is shaped, serviced and distributed in the United Kingdom by the Triplex Company. It has been approved by the Air Ministry for use on all types of British aircraft and is now being widely adopted. *(Continued in next col.)*

Indices to the equipment described in this section and to the names of firms will be found on page 535.

Perspex is very light in weight and can be shaped and machined accurately. It is not adversely affected, it is claimed, either by varying atmospheric conditions or by exposure to moisture or sea-water. It retains its good mechanical properties both at sub-zero temperatures and in ageing.

Triplex goggles and windscreens are also in considerable demand. By a new process of manufacture the discoloration risk has been overcome.

61 DAVID MOSELEY AND SONS, LTD., Chapel Field Works, Ardwick, Manchester.—This company's principal product for use in the aircraft industry is "Float-on-Air" pneumatic seating. This type of seating is designed on a tubular principle which very effectively eliminates rolling and enables complete support to be given with a seat depth of 2½ in. to 3 in. This "Float-on-Air" upholstery, it is stated, completely absorbes all engine vibration and greatly reduces fatigue and, in addition, provides a very light type of seating.

It has been used by Mr. C. W. A. Scott, Mr. and Mrs. J. A. Mollison, and Miss Jean Batten in making record flights.

David Moseley and Sons also manufacture rubber blocks, rubber strip, engine-mounting blocks, sparking-plug covers, and various types of petrol and oil-resisting tubing.

62 METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, include many products of interest to manufacturers and operators of aircraft. Among the most important are electric motors, generators and control gear; electric welding equipment; fans suitable for operating wind tunnels; "Cosmos" lamps for aircraft interiors and landing lights, and for factory and office lighting; electric discharge lamps for lighting large areas; and electrical measuring instruments of many kinds for use in aircraft and on industrial switchboards.

The various kinds of electric welding equipment available include that for the resistance (spot and seam) and atomic hydrogen processes.

Another Metrovick product, type M-V "C" (patent) aluminium alloy, is already widely used by aircraft constructors. It is a high-grade aluminium silicon alloy of exceptional purity, lighter than aluminium, and in strength and ductility exceeding the requirements of Admiralty, Air Ministry, and B.S.I. Specifications. The alloy is supplied in the form of rolled sheet, drawn rods and tubes, forgings, stampings and castings. It is easy to machine, takes and keeps a good polish, and is easily welded.

63 MAY AND BAKER, LTD., Dagenham, London.—Rhodoid transparent sheets are supplied to the aircraft industry in thicknesses from 1 mm. to 6 mm. for the manufacture of windows and windscreens. Rhodoid may be formed or moulded for curved windscreens, gun turret windows, coupé tops, lamp fronts, etc. Transparent sheets are also supplied in thinner substances for inspection panels, draining eyelets, and instrument and chart covers.

Black, white, and opaque colours are used for instruction plates and labels, and black Rhodoid is also used extensively for moulded fairings. Translucent Rhodoid in a variety of colours and finishes is supplied for illuminating panels and lampshades. It is also being used for decorative panelling.

Rhodoid is non-inflammable, conforming with the British Standards Specification F.56. The transparent sheets are of excellent clarity, and no discoloration is discernible even after prolonged exposure.

64 MASSON, SEELEY AND CO., LTD., 14, Howick Place, London, S.W.1.—The "Masseeley" radial grinding attachment, which fits all tool and cutter grinders, makes possible the modification of existing milling cutters to the desired profile for milling radii, internal or external. In this way, cutters which might otherwise be lying unproductive in the stores can be utilised, the cost of modification reduced to a fraction of that of a new cutter, and delay in manufacture avoided, whilst at the same time ensuring that the modified cutter has the exact radius required.

In use, the "Masseeley" attachment is bolted to the table of the grinding machine, the milling cutter mounted on its arbor between the centres, and the edge of the cutter located by the setting block. The compound slides are then adjusted so that the centre of the arc to be ground lies on the axis of rotation of the attachment. Finally, the table of the grinding machine is moved until the teeth of the milling cutter occupy the correct position relative to the grinding wheel.

The operation of grinding consists of traversing the machine table towards the working face of the grinding wheel whilst oscillating the attachment.

65 MARCONI'S WIRELESS TELEGRAPH CO., LTD., of Electra House, Victoria Embankment, London, W.C.2, have been actively engaged in aircraft wireless research and in the design and manufacture of wireless equipment for aircraft since the earliest days; and its aircraft and aerodrome wireless installations are in daily use in all parts of the world.

Marconi apparatus is used almost exclusively on the Empire air routes, the aerodromes of which are also being equipped with Marconi-Adcock anti-night-effect direction finding receivers and aerials.

Wireless research and development is undertaken at a special Marconi Aircraft Wireless Establishment, where the wireless equipment for the Empire flying boats has been designed and manufactured. This establishment has also been responsible for the production of the Marconi ignition screening harness.

Marconi apparatus is available for all types of aircraft, for telegraph and telephone communication, for use on medium, short and ultra-short waves, and for D/F. work.

The Marconi Type A.D.57/5872/626 transmitting and receiving installation is the most complete set yet designed for large aircraft flying over long distances, and is the one used on the Empire boats.

Medium- and ultra-short-wave approach and landing beacons manufactured by the Marconi Company incorporate numerous advantages.

66 BIRMETALS LTD., Dartmouth Road, Smethwick, Birmingham, a subsidiary company of Birmid Industries,

Ltd., have recently purchased a very large estate at Woodgate, near Quinton, and building operations have commenced on a new rolling mills. The works will be equipped with the latest design of rolling mill plant, extrusion presses, electric furnaces, electrical and mechanical plant, etc., for the production of high-tensile aluminium and magnesium alloy sheets, and also extrusions and drawn sections in the same alloys.

67 THE MALLOCK - ARMSTRONG EAR DEFENDER CO., 39, Victoria Street, London, S.W.1.—The Mallock-Armstrong ear defender has been employed successfully on many long flights and is used extensively by the industry, particularly in engine test shops, where its unique feature—that of permitting the passage of ordinary sounds with scarcely diminished volume, while protecting the wearer from injury due to excessive noise—is greatly appreciated. Temporary deafness after long flights, or after prolonged exposure to any loud noise, is, it is stated, completely eliminated.

68 MAGNESIUM ELEKTRON, LTD., Clifton Junction Works, Manchester, an associated company of F. A. Hughes and Co., Ltd., the introducers of Elektron, have laid down a plant near Manchester where Elektron will be produced in sufficient quantities to meet all present and future demands. Production will commence within a few weeks.

So widely is Elektron used in the aircraft industry that practically every machine in the air to-day incorporates some vital part made of these alloys. The most outstanding applications of Elektron in the manufacture of aero engines are for crank cases, valve-gear cases, carburetter bodies, induction casings, and for many components in the oil-circulating ignition and petrol-supply systems. In airframe construction it is used for landing wheels, chain guards, axle blocks, control wheels, cowling, sheet formation, etc.

69 JAMES C. NICKLIN, LTD., Cross Street, Smethwick, specialise in aircraft steels and duralumin in sheets, bars and tubes, and in all metals for the aircraft industry.

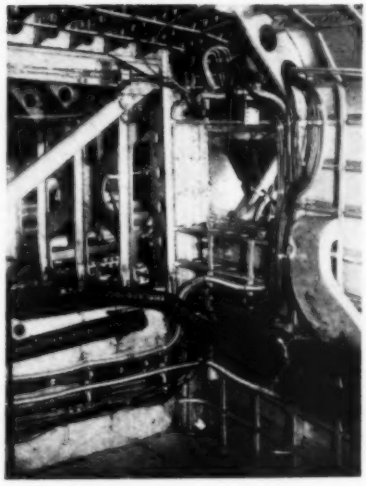
The metal used in the construction of the Percival Gulls which figured so prominently in the recent flights by Mr. C. W. A. Scott to Johannesburg and Miss Jean Batten to New Zealand, was supplied by this firm from stock. Large stocks are always maintained and immediate deliveries given.

70 COLAS PRODUCTS, LTD., Norman House, 105-109, Strand, London, W.C.2.—Maintenance of aerodrome runways becomes a relatively simple matter when plastic surfaces are adopted. Bituminous emulsion provides the means of constructing such areas easily and economically.

Broadly speaking, two methods are available; stabilisation of the existing earth surface or grouting of a superimposed layer of imported aggregate. In the first case, an emulsion such as "Terolas" is employed, while in the second Standard Colas emulsion is used. Both types of construction are surface-dressed with Standard Colas at 4 sq. yds. per gallon, and blended with suitable hard chippings.

71 THOMPSON BROS. (BILSTON), LTD., Bilston, Staffs.—For the last year or two the special mobile refuelling unit made by this firm has been seen on the majority of the larger aerodromes in this country. Apart from two very well-known fuel suppliers, an aircraft manufacturer, an air transport company and three flying schools, each have one of these mobile pumps.

This unit has, as a matter of fact, been modified and improved within recent months. The capacity has been increased from 350 to 500 gallons and the pumping rate from 20 to 45 gallons a minute. In addition to its value in the business of really



Callender cables in the interior of one of the Short Empire flying boats (91).

quick refuelling, this unit can also be utilised for towing machines and can be fitted for oil and compressed air delivery when required.

72 SUPERFLEXIT LTD., Trading Estate, Slough, Bucks.—Flexible pipe lines of various sizes are universally fitted to aircraft, since the necessary flexibility of an airframe puts rigid piping out of the picture save where this is being used over short distances or between points mounted rigidly in relation to one another. Superflexit is of the non-metallic type and the unions are permanently attached. The special lining is insoluble and impermeable by any normal fluid, so that even with the most volatile liquid there can be no evaporation through the walls.

This tubing is sold in all normal lengths and in sizes from ⅛ in. to 8 in. bore. Several very interesting tests have been carried out on Superflexit by the R.A.E. at Farnborough and the results, it is stated, have been highly satisfactory.

73 STREAM-LINE FILTERS, LTD., Hele-Shaw Works, Ingate Place, London, S.W.8.—The oil filter produced by this firm is of simple static design, removing all solid matter, including colloidal carbon, from the lubricant and recovering more than 98 per cent. of the oil which is actually available for recovery. A full range of filters is produced with outputs as low as 5 gallons a week or as high as 30 gallons an hour. The filters are in use in the Services here, in Canada, and in Australia, and can be operated entirely by unskilled labour.

74 TECALEMIT, LTD., Great West Road, Brentford, Middlesex.—Representative examples of Tecalemit greasing and fuel pump units, as well as air and oil cleaners, will be exhibited at the Paris Show. Most of the normal fittings are now available in lighter alloys, and many of the company's products have been in Service use for more than twelve years.

Among the items showing at Paris are the aircraft lubricant compressor delivering a pressure up to 5,000 lb./sq. in. and weighing only 3½ lb., an engine fuel pump of the mechanically operated type with a hand priming lever, a duplex pump suitable for inverted and aerobatic flying, and the normal type of oil cleaner. In addition to these exhibits the company, of course, produces suitable nipples and nipple groups for both direct and group greasing, as well as two and three-way regulators for the latter system.

75 STERLING METALS, LTD., Coventry.—Specialists in magnesium castings during the past ten years, this company are also the pioneers of Elektron magnesium castings in this country and are probably the only firm which has a magnesium foundry entirely devoted to aircraft production. Sterling Metals supply aluminium alloy castings to many constructors and engine builders and are now in a position to deliver light forgings in aluminium and magnesium.

76 TROUGHTON AND YOUNG, LTD., 143, Knightsbridge, London.—The importance of correct lighting in airport offices, booking halls and waiting rooms, cannot be over-estimated, and this company produces a very special range of efficient fittings designed for installation at any angle and for any particular purpose. Apart from more normal hanging globes and wall lights, this company produces multiple units which can be arranged in a variety of ways to make continuous lighting troughs on ceiling or wall surfaces, and the metal work in all cases can, if desired, be cellulosed in six different colours.

The appearance of larger transport machines equipped for night flying suggests a new development in such fittings, when these would need to be both light in weight and, like their prototypes, efficient.

77 P. B. DEVIATOR, LTD., 42a, Sydenham Road, Croydon, Surrey.—This firm is probably best known for its three-axes automatic pilot. Of simple construction and hydraulically operated the P.B. automatic control has over 1,000 hours' flying in various types of machine to its credit. Ease of maintenance and installation are its principal features. Less well-known but equally interesting is the Deviator, which is a visual indicator for blind flying, showing actual movements of an aircraft, both in pitch and yaw, on the same pointer. It is mechanically driven either from the engine or from a small windmill by flexible shaft.

78 PYRENE COMPANY, LTD., Great West Road, Brentford, Middlesex.—There are many situations in the aircraft industry which call for efficient fire appliances of various types. A wide range of apparatus is manufactured by this company and the best known is the standard Pyrene extinguisher. This embodies a double-acting, rotating pump, which projects a powerful and continuous jet of liquid at any desired angle. The special liquid is converted into a vapour immediately it meets the fire.

Pressure-type extinguishers are also supplied, charged either with Pyrene liquid or methyl bromide, and in the latter case they are approved by the Air Ministry for aeroplane protection. This model can be operated by one hand. Extinguishers are also supplied with a distributing system. Phomene foam appliances are very effective in dealing with blazing oils and spirits, and are made in a range of hand extinguishers, chemical engines, and foam generators. The foam-making branch-pipe is one of the latest and most satisfactory foam units and can be carried and used by one man.

79 JOHN B. PILLIN, LTD., of Church Hill, Beckenham, Kent, are specialists in lubricating equipment and air compressors. Their compressors range from 3 cubic foot single-stage to 24 cubic foot two-cylinder two-stage models, and many of these compressors incorporate entirely new designs. They are particularly suited to aerodrome service.

The latest departure of this company is the J.P.B. hoist, which does not "sit" on air when sustaining the load.

Indices to the equipment described in this section, and to the names of firms, will be found on page 535.

80 THE RAGOSINE OIL CO., LTD., 17, Blenheim Terrace, Woodhouse Lane, Leeds, 2, supplies Minix aero oils, which are approved by the leading engine manufacturers and by the Air Ministry. They are also suppliers of anti-freezing oil and grease, hydraulic brake fluid, penetrating oil and running-in compound. They are able to arrange for supplies to be held throughout the world, and are among the pioneers of oil manufacture.

81 JAMES H. RANDALL AND SON, LTD., Green Street Works, Paddington, W.2.—When looking up old records this firm has found entries as long ago as 1907 referring to pipes for aeroplanes. Again, in 1909, there are entries having reference to copper bends for aeroplanes, while between 1910 and 1914 there are numerous entries. During the last war the firm was almost wholly engaged on aircraft work.

Randalls have been engaged in the manufacture of almost every component and part in sheet metal from tanks to radiators. They are on the A.I.D. list and have fulfilled numerous sub-contracts for the leading aircraft builders.

82 RANSOMES, SIMS AND JEFFERIES, LTD., Orwell Works, Ipswich.—The problem of the upkeep and maintenance of aerodromes, as well as the preparation of new ones, is becoming more and more important. This firm offers a range of implements for work such as levelling and draining, laying cables, cutting and cultivating grass, etc. Machines which deserve special mention are their gang mowers, which can be supplied up to 25 ft. in width, their rotary scrapers for levelling and their mole drainers, which can be used not only for drainage but also for cable-laying.

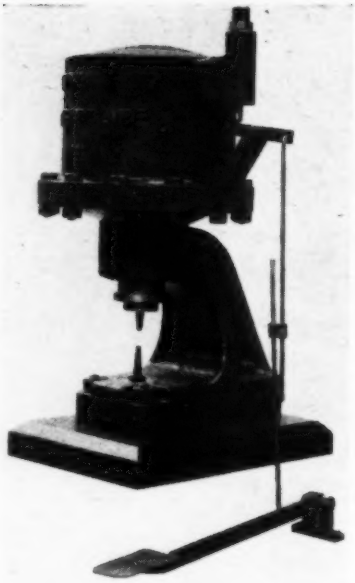
83 REDWING AIRCRAFT CO., LTD., Croydon Airport, Surrey.—This company was formed in 1929, and designed and built a number of two-seater civil aircraft. At the present time it is concentrating on the production of jigs and tools for aircraft parts and the production of all types of metal fittings and components. The works are well equipped for the complete production of aircraft parts, and a large plant for anodic treatment has recently been installed.

84 REYNOLDS TUBE CO., LTD., Hay Hall Works, Tyseley, Birmingham.—For many years the name Reynolds has been associated with seamless steel tubes, and, latterly, with tubes of aluminium and magnesium alloys. These products are probably used in every type of airframe constructed in this country.

A recent addition to their activities is the manufacture of built-up steel tubular structures, such as engine nacelles, while some two years ago the company started the manufacture of aluminium alloy tubes and extruded sections. The last are supplied in a variety of shapes, sizes and thicknesses, many previously considered impossible. An associated company, Reynolds Rolling Mills, Ltd., for the production of aluminium and magnesium alloy sheet and strip, has recently been formed.

85 ROBERTSON COOLERS, LTD., of 211a, Acton Vale, London, W.3, are supplying manufacturers with lightweight oil coolers to suit a variety of machines. They have a large range of sizes available and can co-operate with designers in the selection and adaptation of units to deal with any requirements. The type of solderless joint used in the coolers has been well tested over a number of years.

Units can be made by this company for air, water, ethylene-glycol and oil, and in all cases this solderless type of jointing is used for the elements. The use of small section aluminium elements permits a high cooling efficiency in relation to bulk and weight, and these qualities have been very useful in developing oil coolers for cabin heating systems.



A pneumatic bench riveter by Broom and Wade Ltd. (92.)

86 L. A. RUMBOLD AND CO., LTD., of Kingsgate Place, Kilburn, London, N.W.6, are still carrying on much as before—that is to say, doing most of the civil aircraft decorating and furnishing in this country. Besides silencing and decorating machines, this firm supplies all manner of internal fittings and has recently been approved by the A.I.D. and so is able to quote for interior fittings for Service machines.

At the moment Rumbold's are carrying out the interior decoration of the Short Empire boats, and their work in making machines almost silent for the passengers must not be forgotten. Two or three new types of chair are coming along; these will be fully reclining and automatically controlled. A parachute conversion in a Caudron will be on show in Paris.

87 LONDON ALUMINIUM CO., LTD., Witton, Birmingham, 6. With long experience of aircraft aluminium work—which it was handling as long ago as 1914-18, this company is in an excellent position to cater for the present increased demands in aircraft components. Spinnings for variable-pitch airscrews, petrol tanks, fairings, rings and similar parts are now being produced in bulk quantities. Shallow-draft pressings up to 6ft. by 4ft., small and intricate spinnings, and large spinnings as much as 6ft. in diameter are notable production features. Precision pressings, stampings and hand-press work in aluminium and dural alloy also form a regular output for aircraft constructors. Anodising by the Bengough approved A.I.D. process is also operated and sheets up to 36 sq. ft. may be treated by this method.

88 BOULTON AND PAUL, LTD., 139, Queen Victoria Street, London, E.C.4. Steelwork lends itself to rapid construction in the case of hangar and factory erection, and, bearing in mind its other qualities of adaptability, durability and mobility, is an excellent medium to employ whatever the need and urgency of the case. As an example may be cited the workshop hangar at Heston, which has a floor area of 32,450 sq. ft. and an unobstructed single span of 200ft. The steelwork of this impressive building occupied from first to last only fourteen weeks, the fabrication and erection taking considerably less time than this.

The hangar was built for Airwork Ltd., by Boulton & Paul, Ltd., who are specialists in steelwork construction. This firm also constructed the seaplane erecting shop for Saunders-Roe, Ltd., at East Cowes, a notable landmark, and the 550ft. by 80ft. hangar specially designed to follow the track at Brooklands.

89 BOSTON BLACKING CO., LTD., Ulverscroft Works, Leicester.—Among the various "Bostik" aircraft cements, special mention may be made of No. 292 universal cement for glazing, and No. 321 white cement for shell plate sealing of floats, hulls, and fuselage.

The former prevents rain from leaking round the edges of the glass in cabin type aircraft, even in the worst storm, while the latter is almost indispensable on metal aircraft, as not only does it make a waterproof joint, but also definitely has a much stronger grip on all types of metal used in aircraft construction and there is no danger of flaking.

No. 103 Bostik is used where there is any possibility of petrol or grease coming in contact with the joint, and for work involving the fixing of rubber, leather cloth, fabric, etc., to metal, two grades of Bostik are used, No. 325 and No. 292C.

It has been definitely established, it is stated, that Bostik adhesives have no detrimental effect on duralumin and similar metals.

90 D. H. BONNELLA AND SON, LTD., 46-48, Osnaburgh Street, Euston Road, London, N.W.1, are manufacturers of aero engine component parts and aircraft equipment, and their works are equipped with the most modern plant and machinery. Their bakelite moulding plant has been considerably extended to cope with the demand for this class of work now so extensively used in the aircraft industry, the moulds being made on the premises.

D. H. Bonnella and Son have been on the list of firms approved by the Air Ministry since 1926, and are authorised to release their products as to material, dimensions, efficiency, and functioning tests. All material is purchased from approved firms.

91 CALLENDER'S CABLE AND CONSTRUCTION CO., LTD., Hamilton House, Victoria Embankment, London, E.C.4, have for many years supplied leading aircraft manufacturers with electric cables and flexibles for aircraft and aero-engine use, made in accordance with Air Ministry Specification D.T.D.172B., B.S. Specification 4E. 3 and also other Air Ministry provisional Specifications. In addition, they supply exclusively to Imperial Airways, Ltd., a special type of electric cable that has been produced for that concern.

In the Empire flying boats the electric installation is most comprehensive and each boat is being equipped with well over one mile of Callender aircraft cable.

Callender's supply, in addition to all the normal types, aircraft cables with special cellulose finish and radio-screened finishes.

92 BROOM AND WADE, LTD., High Wycombe, well-known makers of air compressors and pneumatic tools, have lately given particular attention to aircraft industry requirements, and have introduced several new types of riveter, drill, grinder, etc.

One of these is a bench-mounted riveting machine intended for forming small rivet heads by compressive action. It is available in two sizes; the larger has a capacity for closing steel and duralumin rivets of $\frac{1}{16}$in. and 5/32in. diameter respectively, and can also be employed as a power punch for work requiring a pressure up to 2½ tons. The frame which forms the support and gap for the work gives depths of from 4in. to 40in.

Another new tool is the long-stroke riveter,

which weighs 6¾lb. and is 16¾in. long. Operating with a maximum speed of 200 blows per minute it can close steel rivets up to 3/16in. diameter or duralumin rivets up to 5/16in. diameter.

Of other pneumatic tools for the aircraft industry, apart from chipping hammers, yoke riveters, multi-vane drills and grinders, available in various sizes, of particular interest is the new PB120 type hammer. It is well suited for light riveting, chiseling and similar work where spaces are very confined. There is also a new SX1 type rotor drill which, having a drilling capacity of 3/16in. and an average free speed of 2,700 r.p.m., weighs only 1¾lb. and is 9¾in. long.

For the operation of pneumatic tools, the firm manufacture single-stage and two-stage air compressors.

A Chance flush-mounted runway marker. (99)

93 THE BRITISH PISTON RING CO., LTD., Holbrook Lane, Coventry.—Close contact which this company has had with important aero engine manufacturers enables them to keep in touch with all the latest developments and requirements. Components manufactured by this company cover: (1) piston rings and scraper rings, made to the Specification 4K6 and also in the following Brico special materials: Brilybdenum (the latest Specification D.T.D.277, having an increased E.N. value, less permanent set and an increased tensile strength) and Brimol (stainless). An austenitic cast iron possessing anti-corrosive properties.

(2) Cylinder sleeves: centrifugally cast in special alloys for sleeve valve engines; (3) cast-iron bushes; (4) gland rings: cylinder head rings, bearing retainer rings and similar rings for various purposes made in hardened and tempered high speed steel.

A subsidiary company, British Aero Components, has recently been formed expressly for the manufacture of components for aero engines, in particular sodium-cooled and other valves, under the patents of the Wilcox-Rich Corporation of Detroit.

94 MOSS BROS., AND CO., LTD., Covent Garden, London, W.C.2.—Moss Bros. have produced a flying suit which combines a number of useful points. It is made of a very pliable nappa leather, black to conceal oil marks. It is in two pieces, as so many pilots to-day wear flying suits for short trips. For quick and convenient handling, Zipp fasteners are at all stragetic points such as map pocket, shin pockets, and down the side of the coat. The trousers are fitted with a broad elastic waist band.

Another innovation is an air travel bag, weighing 4lb. 10z. It is made of canvas with cowhide base and handles, Zipp fastened.

95 THE BRITISH ALUMINIUM CO., LTD., Adelaide House, King William Street, E.C.4.—Aluminium and its alloys are covered by the familiar A.I.D. specifications, planned to meet the strenuous conditions of modern service equipment. Pure aluminium has its own specifications, as have the familiar casting alloys 3.L.5, 3.L.8 and 4.L11. Pure aluminium sheet in hard, half hard and soft tempers; pure aluminium rod and sections, tubing, treadplate and rivets all have separate specifications. Aluminium alloy rod for machined parts is covered separately.

All of the foregoing is within the range of products of the British Aluminium Company, Ltd., whose chain of works in Great Britain and Northern Ireland has always devoted a goodly proportion of output to aircraft requirements.

96 CHILLCOTTS, LTD., 1-4, Trinity Place, Trinity Street, Borough, London, S.E.1, specialise in gaskets in Vellumoid (for which they are the sole agents in the United Kingdom) and Fibracork, the latter being a comparatively new jointing, which consists of high quality cork covered both sides with special petrol- and oil-resisting vegetable fibre. Vellumoid and Fibracork are approved and used by the Air Ministry. Chillcotts have a separate department dealing with all classes of sheet metal work up to 18 gauge, in addition to which they are manufacturers of an exceedingly useful truck for the easy transportation of gas cylinders.

Their latest production is a cutting gauge known as the "circut" Attachment, for accurate acetylene cutting of holes in steel plates up to practically any thickness.

97 V. L. CHURCHILL AND CO., LTD., Walnut Tree Walk, Kennington, London, S.E.11, manufacture a range of equipment of unquestionable interest to the aircraft industry. Perhaps the most important item is the VLC No. 44U valve refacer, a precision machine which has been supplied in quantity to the Air Ministry. It is suitable for valves with stems ranging from ¼in. to 5/8in. The valve face can be ground true to the angle of the valve seat, and concentric with the valve stem. Attachments are supplied which permit the complementary grinding of valve-seat cutters. A ¼ h.p. electric motor supplies the power.

The V.L.C. 50-ton hydraulic press is equally useful for heavy or sensitive work, such as pressing bearings, etc. Twin pumps are fitted, one of which enables the ram to be brought down quickly to the work and the other for the actual work.

A third V.L.C. speciality is a range of tool boxes and trays.

98 THOMAS CHATWIN AND CO., Great Tindal Street, Birmingham, 16.—This old established firm specialises in the production of aircraft components and is organised to give regular deliveries in large quantities. Chatwins are well known for their screwing machines and small tools. Over £20,000 worth of taps, reamers, stocks and dies, and drills are stocked, so prompt delivery is ensured. A complete range of hand and power screwing machines with capacities from ¼in. bolt to 6in. pipe is available.

99 CHANCE BROS. AND CO., LTD., Lighthouse Works, Smethwick, Birmingham, have equipped a considerable number of aerodromes in this country with lighti..g equipment, amongst which may be mentioned Heston, Gatwick, Southampton and Doncaster.

Abroad, their equipment is in operation in India, Canada, Australia, South Africa, Rhodesia, Egypt, Iraq, Palestine, Belgium and other countries, and they have supplied a number of different types of beacons, floodlights, etc., to the Air Ministry, which are now in operation in different parts of this country and abroad.

Chance Bros. have had sixteen years' experience in the design and manufacture of lighting equipment for aerodromes and airways, and amongst their activities they include the supply of floodlights, beacons, boundary lights, obstruction lights and wind indicators, together with generating plant which can be designed to operate automatically up to a period of two months without attention of any kind.

Indices to the equipment described in this section, and to the names of firms, will be found on page 535.

100 CELLON, LTD., Kingston-on-Thames, Surrey.—This well-known firm of dope and finish specialists have recently developed new products, two of which are worthy of special mention.

With increasing speeds at high altitudes a demand has arisen for matt non-reflecting surfaces, which has been met by the introduction of matt cellulose finishes.

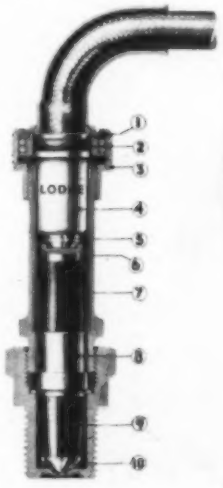
The Bristol 138 monoplane which secured the world's record of 49,967 feet was finished on all upper surfaces with the new Cellon matt cellulose finish, with the object of reducing reflection from the terrific sun glare which is experienced at such altitudes.

A similar type of finish is also produced in the "Cerrux" synthetic range, for use on stressed metal covering.

The flockage process for reduction of resonance on metal and other surfaces (Michel and Marchal, Patent No. 394827). It is not an exclusive Cellon product, but the company has secured the sole rights for the United Kingdom and Ireland.

Briefly, the method followed is to apply a special adhesive to the inner surfaces of all metal panelling, etc., and whilst it is still in the tacky stage to apply fibrous particles of wool or cotton under high pressure through a special type of spraying equipment. Two such applications at 48-hour intervals effect a very considerable reduction in resonance of panels, drumming, etc., and produce a finish which is in itself protective and non-absorbent.

The process is receiving practical test in several of the new Empire flying boats.



The Lodge radio-screened plug (Paragraph 103) in section. The parts numbered are as follows: (1) metallic seal, (2) rubber seal, (3) self-locking nut, (4) steatite sleeve, (5) nickel contact, (6) centring cup, (7) mica insulation, (8) compressed steel bush, (9) mica insulation, (10) low-voltage spark-gap. (Paragraph 103)

101 BRITISH TIMKEN, LTD., Cheston Road, Aston, Birmingham, 7.—Among the Timken tapered roller bearings is one specially designed for rocker gear. Of the cageless type, it has two full rows of tapered rollers, giving, in the space available, the maximum capacity essential to resist hammering action. It is preadjusted at manufacture and is completely self-contained. This type of bearing resists simul-

taneous radial and thrust loads from all directions, affording a rigid support to the rocker arm pivot. A number of well-known engines utilise these rocker bearings.

Another important application of Timken bearings to aircraft is to the landing and tail wheels, a series of lightweight bearings being available. All wheel slackness is eliminated by close adjustment of the bearings, and the thrust carrying capacity of the bearings is of particular value in dealing with the thrust loads which are always in evidence when landing. They have been extensively used on British civil and military aircraft.

Bearings are also supplied in stainless steel for amphibian machines.

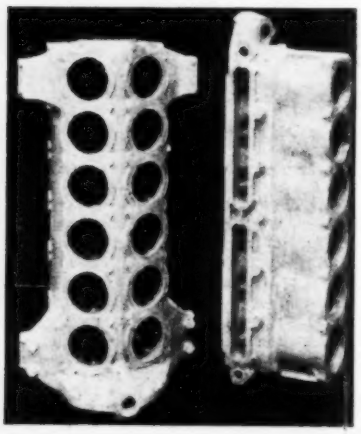
102 THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Magnetos suitable for all aero motors with from two to 24 cylinders are manufactured by B.T.-H. in a specially equipped factory at Coventry. The reliability of B.T.-H. magnetos is well demonstrated by their performance in many notable flights.

The company also manufactures various types of electric starters, together with aircraft air compressors. Among other items may be mentioned Mazda lamps for illuminating hangars, aeroplane cabins and floodlighting aerodromes; electric motors and control gear for the manufacture of aircraft; electrical equipment for wind tunnels; 16 mm. sound reproducers for training operators; and sound-amplifying equipments for announcements on flying grounds.

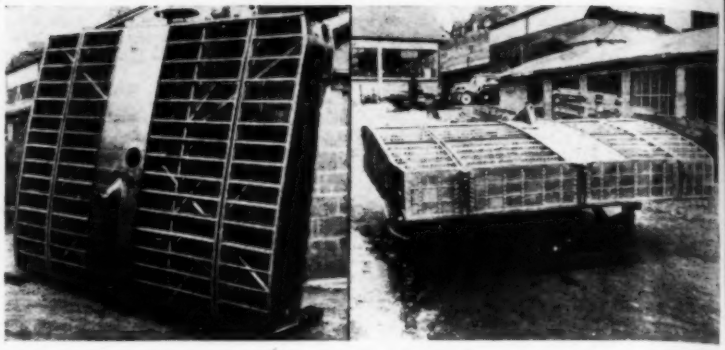
103 LODGE PLUGS, LIMITED, Rugby, England.—Typical of the extensive Lodge range will be the plugs shown at the Paris Exhibition, in 12 mm., 14 mm. and 18 mm. size threads. The plugs shown are those types approved for and used in a score of British and foreign engines.

In addition will be shown a complete range of the Lodge radio-screened plug. The screen, as will be seen on the previous page, forms an integral part of the plug. The materials used make the plug suitable for all aircraft, including seaplanes, the complete fitting being rain- and spray-proof and resistant to the action of salt atmosphere. Types are available for all makes of aero engines. There are models with 18 mm., 14 mm. and 12 mm. thread with different lengths of reach.

104 E. B. MEYROWITZ, LTD., 12, Old Bond Street, London, W.1.—The manufacturers of Luxor goggles have always tried to be first in the field with any new design or idea relative to flying goggles, since they have been designing goggles of this type from the time aviation started. As soon as they heard that a synthetic resin



Crankcase castings by Heritier, Ltd. (224)



De Bergue riveted fuel tanks made by Short Bros., Ltd., of Firth-Vickers stainless steel. (211 and 109)

substance was being used in place of lenses they spent considerable effort and time in obtaining the very finest type of synthetic lens obtainable, and as a result they are now offering the No. 6 model fitted with these lenses at 45s. They point out that there are several goggles which are being supplied with a type of synthetic lens, but special claims are made for the Meyrowitz design.

105 THE MANGANESE BRONZE AND BRASS CO., LTD., Caxton House, Tothill Street, London, S.W.1.—The extensive range of "Oilite" self-lubricating bronze bearings is of particular interest to manufacturers of all types of aircraft and associated components, because it is claimed that in addition to satisfying the most exacting requirements of strength and load-carrying capacity their construction is such that they contain up to 40 per cent. volume of lubricating oil. This property renders them particularly useful in inaccessible positions subject to extremes of temperature. For instance, "Oilite" bushes were employed on the Curtis Wright Condor used during the Byrd Antarctic Expedition and gave entire satisfaction.

These bushes were also incorporated by Short Bros. in the construction of the Empire flying boats. Amongst the many applications of "Oilite" bearings in the aircraft industry are engine and carburetter controls, flaps, retracting gear, elevators and ailerons and exhaust ring bearings, etc. They have been approved by the Air Ministry for loads up to 3,000 lb./sq. in.

106 CLARKE, CHAPMAN AND CO., LTD., Victoria Works, Gateshead, Co. Durham, have for many years been manufacturers of all types of searchlight projector equipment and are on the British Admiralty, War Office and Air Ministry lists for this class of work.

They manufacture equipment such as aerodrome beacons, boundary and obstruction lights, illuminated tee type wind indicators, aerodrome floodlights, ceiling projectors, wind-velocity indicators and strip-type landing lights.

In addition, they produce all classes of searchlights and low- and high-intensity projector lamps of the semi-automatic and fully automatic type, and generating equipment.

This firm has recently marketed a special stand-by generating equipment which can be arranged for automatic starting either by light sensitive devices, automatic control device or by failure of a main supply.

107 CELLACTITE AND BRITISH URALITE, LTD., Lincoln House, 296-302, High Holborn, London, W.C.1.—Cellactite roofing, vertical cover and interior walling is widely popular in the aeronautical community, having been adopted by the Air Ministry, Handley-Page, Ltd., Fairey Aviation Co., Short Bros., Bristol Aeroplane Co., and others. It is said to be a splendid insulator, thereby ensuring comfortable atmospheric conditions within the building on which it is used, and its powers of insulation also ensure economy in heating systems, preventing heat loss.

Cellactite is a material which is unbreakable as well as incorrosible; it is easily fixed, and is available in large quantities for speedy erection.

108 FLEXO PLYWOOD INDUSTRIES, LTD., South Chingford, London, E.4, manufacture plywood to the B.E.S.A. specification 4V3. They are also busy on interesting developments, one being the use of an inorganic Bakelite type of cement. It is stated to give a vastly improved plywood as it is not only waterproof but, being inorganic, is unaffected by bacteriological action which is likely to take place in the humid climates.

Also, Flexo Plywood have lately been co-operating with a well-known aircraft manufacturing company in the construction of plywood in which the grain runs at an angle of 45° with the edges of the panel; in some special instances the core or centre layer of veneer is deliberately made twice the thickness of the face and back so that equal strength is obtained both longitudinally and transversely with the grain of the face veneer. Used for fuselage skins, etc., it is understood to be giving some very remarkable results.

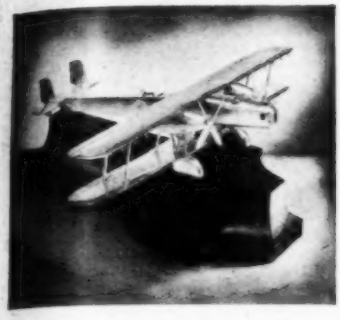
109 FIRTH-VICKERS STAINLESS STEELS, LIMITED, Staybrite Works, Sheffield, 9.—The development of all-metal airframe construction is now common to the majority of service types, whilst a considerable proportion, including the products of almost all the well-known firms, make extensive use of Firth-Vickers non-corrodible steels.

These are in three main types: 12 per cent. chromium (high and low tensile); 18 per cent. chromium, 2 per cent. nickel (high tensile); and 18 per cent. chromium-8 per cent. nickel.

110 R. H. COOK AND CO., LTD., 209, Broadway, Hendon, London, N.W.9., are manufacturers and exporters of a comprehensive range of small tools and equipment useful for aeroplane reconditioning and engineering workshops. These include electric drills, slings, 10-ton straightening presses, lifting gear, testing batteries, portable benches, electric self-centring inspection lamps, air compressors, spray paint plants, high-pressure greasing equipment, welding plants and aircraft engine cranes.

The last-named is a very efficient piece of equipment for any aircraft repair depot; it can be wheeled to the machine, the engine extracted with ease and safety, and wheeled away to the engine bench, the whole being accomplished by one man.

111 THOS. FIRTH AND JOHN BROWN, LIMITED, Atlas and Norfolk Works, Sheffield, 1.—Progress with the expansion programme has brought in its train a considerable demand for high-powered engines, which are being supplied



A fine presentation model of a Heyford by The Goldsmiths and Silversmiths Company. (125)

largely by four firms. Firth-Brown have, for many years, been closely associated with three of these firms in metallurgical development, and produce a full range of carbon, nickel, nickel-chromium and nickel-chromium-molybdenum steels, as well as the more recent nitrogen-hardening steels, to Air Ministry specification.

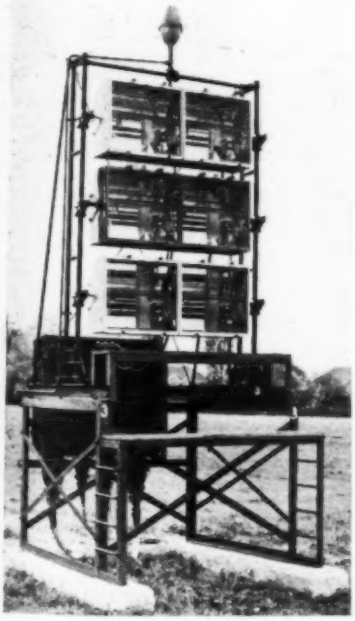
A further recent development of some importance is the supply, in considerable quantities, of the 1½ per cent. manganese (weldable) high-tensile steel to specifications D.T.D. 124A, 137 and 126, for airframe construction.

All steel for aircraft purposes is melted by a specially developed physio-chemical technique in electric arc furnaces, to a rigid standard of inspection.

112 THE EXACTOR CONTROL CO., LTD., Mount Pleasant, Alperton, Middlesex, are manufacturers of the Exactor hydraulic remote control and its allied hydraulic systems.[1] By this method it is possible to transmit with great accuracy even the smallest degree of movement over long distances.

The Royal Air Force, Imperial Airways and K.L.M. use this system for engine control, and the Admiralty and Air Ministry employ it in connection with precision armament requirements. It is also used in aircraft for the operation of trimming tabs, landing lights and variable-pitch airscrew control. It is employed for the throttle and mixture controls of the Short Empire boats.

The Exactor control is now in production under a manufacturing licence in America, France, Germany, Italy and Japan, and may be inspected at the forthcoming Paris Aero Show on the stand of La Societe Francaise de Materiel d'Aviation (Messier, the Undercarriage Specialists).



A G.E.C. aerodrome floodlight. (128)

113 THE ENGLISH STEEL CORPORATION, LTD., Vickers Works, Sheffield, supply, *inter alia*, drop forgings, including, crankshafts, airscrew shafts, hubs, flanges, bosses, etc., to the leading aircraft engine and aircraft builders. These forgings are the result of a constant study of the requirements of the designer and builder of aero engines and aircraft since the days when the first aeroplane left the ground.

The all important question of "grain-flow" has been mastered and the fibres follow the contour of the section, being always at right angles to the main stresses imposed during service, thus offering maximum resistance to failure.

E.S.C. alloy steels are produced to cover a wide range of physical properties, and are used where the engineer requires additional strength with minimum weight. They have enabled manufacturers of aircraft and aircraft engines to overcome many difficulties in the matter of material.

114 THE EDUCATIONAL SUPPLY ASSOCIATION, LTD., Esavian House, 171-181, High Holborn, London, W.C.1.—"Esavian" doors, electrically operated, have recently been fitted to hangars at Speke Aerodrome, Liverpool and Filton Aerodrome, Bristol. The two sets at Speke are each 35ft. 8in. high, one set being 199ft. long and the other 170ft. long. Both are divided in the centre, giving clear openings of 170ft. and 150ft. respectively.

The motor that operates the winding gear is fitted on the meeting upright of each half and, when the button for opening or closing is pressed, the doors glide smoothly into position, though each half weighs over ten tons. A cut-out is provided so that when fully opened or fully closed the doors stop automatically. They can also be stopped in any position by means of a third button.

115 DUNLOP RUBBER CO., LTD., Fort Dunlop, Birmingham.—This famous concern's exhibit at the Paris Show may be taken as representative of their products. Among the selection of Dunlop aeroplane tyres and wheels will be the largest aeroplane tyre and wheel in the world, the Dunlop 26.00-26 equipment for the Armstrong Whitworth monoplanes now being built for Imperial Airways.

Various other types of aircraft tyres will also be shown, including streamline tyres, both medium and small diameter, tread-pattern aeroplane tyres and tail wheel tyres, including the Dunlop Ecta electrically conducting tail wheel. The Dunlop pneumatic aircraft brake will also be shown, together with Dunlop pneumatic gun gear, which is a system of firing machine guns by compressed air. This system can be used in conjunction with the Dunlop pneumatic brake air supply. Compressed air is led from the container by pipe line to the thumb button fitted in the control ring and thence to the gun controls. When it is desired to operate the guns, a slight pressure on the button operates the actuating motors.

Finally, various rubber accessories used in aircraft construction will be shown, including the new artificial rubber compound, "Duprene."

116 THE BRITISH OXYGEN CO., LTD., Thames House, Millbank, Westminster, London, S.W.1, are specialists in the technique of welding and similar processes. Part of their service is complete scientific investigation into the weldability of metals and alloys. Such investigations, it is stated, are being made continuously and result in the establishment of reliable specifications for welding rods of analysis suited to individual requirements, also resulting in the manufacture, under expert hands, of fluxes made from the purest ingredients and having the necessary active fluxing properties to suit the purpose.

117 BONEHAM AND TURNER, LTD., Duke Street, Mansfield, Notts.—This firm specialises in jig bushes, made in standard listed sizes, which are kept in stock, or made to customers' own requirements and drawings.

Their connecting-rod aligning jig checks rods for every type of misalignment, quickly and accurately. A large number have been supplied to aero engine manufacturers.

Precision repetition work of all descriptions is also undertaken.

118 LEWIS BERGER AND SONS, LTD., Homerton, London, E.9.—The products of this company include nitro-cellulose aircraft dopes for ordinary and "adverse conditions" schemes, and for which good penetration, build and tautening properties are claimed; cellulose finishes, including aluminium nitro-cellulose covering of great durability and brightness; enamels, which are extremely elastic and durable and can be burnished with abrasive polishes to a super finish; and clear lacquers for all purposes. Synthetic enamels include, air drying and low-temperature stoving grades. All are to approved Air Ministry specifications.

Aircraft seat in Moseley's "Float-on-Air" upholstery. (61)

119 KELVIN BOTTOMLEY AND BAIRD LTD., Marlow House, Lloyds Avenue, London, E.C.3.—Perhaps best known among this firm's instruments is the K.B.B.-Kollsman sensitive altimeter, manufactured in England. This instrument has been accepted as standard by virtually all air forces and civil transport lines throughout the world. The sensitivity is such that a ready test may be made merely by walking with it up or down a flight of stairs.

Then there is the K.B.B. petrol level gauge, working on the principle of hydrostatic balance. The quantity of petrol is shown on a simple pressure gauge, which is operated by the air pressure required to force air to the bottom of the liquid in the tank.

Thirdly, K.B.B. aircraft compasses are so well known that no detailed description is necessary. Models are obtainable with self-contained electric lighting on the Kollsman-K.B.B. system, which is absolutely "glare free."

The Aldis signalling lamp is another item marketed by this firm, and known to all the aeronautical world; it is much used as a stand-by to W/T. communication over ranges up to ten miles in daylight and twenty miles by night.

Lastly, there is a vibrometer used in the analysis of vibration such as is commonly experienced in aircraft. It is of very simple mechanical design and makes use of the familiar "tuned reed" principle.

120 JAMES BERESFORD AND SON, LTD., Cato Street Works, Birmingham, 7.—The Beresford folding washbasin, as specified by some of the leading airlines, is made entirely of polished non-

corrosive light alloy and is designed to conserve space. It can have an anodised finish if desired. The weight of the fitting is only 7 lb. Equally practical is the Beresford patent aircraft water closet and water tank of two-gallons capacity, in which the water is under air pressure by means of a hand pump fitted into the tank. The supply of water is sufficient for thirty flushings.

121 M.R.C., LTD., 9, Cavendish Square, London, W.1.—The "Teleflex" system of mechanical remote control, for which this firm holds the sole licence, and to which reference has been made on several occasions in *Flight*, has been making rapid progress during the last year both in England and on the Continent. Practically all the leading British aircraft firms, it is stated, have adopted the system for the following applications: Fuel cocks, throttles, servo flaps, undercarriage indication, C.P. airscrews, carburetters, wireless, D.F. loops, landing lights, ventilators, boost control, and various other remote controls on aircraft. "Teleflex" controls were used on the recent altitude record flight, and figure in the equipment of the Short Empire boats.

Advantages claimed for the "Teleflex" system are its compactness, ease of installation, and the fact that no sweating or soldering is required. Its applications are almost unlimited.

122 JOHN LYSAGHT, LTD., Bristol, 2, have erected a number of steel structures for the manufacture and housing of aircraft, and have recently carried out the extensive extensions at the works of the Bristol Aeroplane Company, as well as hangars at Bristol, Plymouth, Weston-super-Mare, and Hamble.

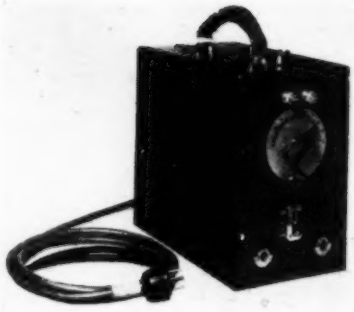
123 NATIONAL BENZOLE CO., LTD., Wellington House, Buckingham Gate, London, S.W.1.—The use of benzole as an aviation fuel has grown enormously during the last year or two, and National Benzole Mixture pumps are now to be seen on nearly every aerodrome throughout the country. Pilots certainly appear to have found the advantages of this powerful spirit, especially its cold weather "startability" properties.

It is claimed that National Benzole is the only motor fuel obtained from coal in this country which is marketed in any considerable quantity.

124 ROBERT KEARSLEY AND CO., York Road, Ripon, Yorks. — "Nulac" synthetic resin finishes for all-metal aircraft are made by a firm which has specialised in finishes for transport vehicles since 1837; their materials were actually used on such historic systems as the Stockton and Darlington Railway. To-day more than sixty of the leading transport undertakings in this country are stated to be regularly using "Nulac" synthetic resin finishes. It is claimed that these finishes are extremely durable, dry quickly, leaving a stone-hard yet flexible surface and give maximum resistance to strong sunlight, torrential rain, climatic changes, alkali-laden atmospheres, etc. They are also oil- and petrol-proof. For purposes other than those of all-metal aircraft Kearsleys supply varnishes, paints, enamels, lacquers, etc.

125 THE GOLDSMITHS AND SILVERSMITHS CO., LTD., 112, Regent Street, London, W.1.—It is no exaggeration to say that there is no finer presentation piece than a sterling silver scale model. Models of any type of aircraft can be produced in silver from photographs or drawings, and the Goldsmiths and Silversmiths Company, who specialise in this work, state that they will gladly submit estimates upon request.

126 GLACIER METAL CO., LTD., Alperton, Middlesex, have now perfected their process for the production of copper-lead lined, steel-backed connecting-rod big end and main bearings. The bearing shows a surface entirely free of segregation



The Transreceiver midget aircraft radio receiver. (137)

of the lead content and of a very low Brinell figure, ranging from 30 to 34. These bearings are being supplied to a number of manufacturers of diesel engines and to one or two aircraft engine constructors, and are understood to be producing excellent results.

Glacier steel-backed bearings lined with Findlay's Motor Metal H.1 are bearings which have shown themselves capable of standing up to conditions of load and speed where it is generally considered that a white metal bearing will not function successfully.

The Glacier Metal Co. claim that they are the largest manufacturers of finished bearings for internal combustion engines in Europe.

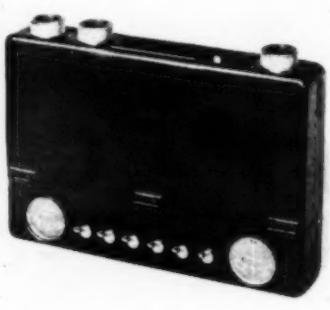
127 GERM LUBRICANTS, LIMITED, Salisbury House, Finsbury Circus, London, E.C.2, claim that the "oiliness" of their products—"Germ" oils—is increased because they are manufactured by the Well-Southcombe process, of which they are the originators and sole exponents. The company has evolved an "oiliness" comparator to prove its contentions. One of these instruments is in constant use at the National Physical Laboratory, where the results obtained are regarded as established facts.

"Germ" oils are sold at all aerodromes of importance in Great Britain and many aerodromes abroad.

128 THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.—As manufacturers of "everything electrical," the General Electric Co., Ltd., naturally figures prominently among British firms contributing equipment to the aircraft industry.

Many aerodromes have been equipped with the Company's floodlight and neon beacons, rotating route beacons, landing floodlights, boundary lights, illuminated wind direction and velocity indicators, obstruction lights, as well as with cables and flexibles, and electricity generating plant.

Aircraft operating from home aerodromes include, in many cases, a good deal of G.E.C. lighting and other electrical equipment. The



A neat example of the Rotax aircraft switchboard. (148)

Company produces a special range of Osram lamps for landing lights on aircraft, and also lamps for cabin lighting, cockpit and dashboard lighting, indicator lighting, etc. It manufactures, too, several instruments for installation in aircraft—among them voltmeters and ammeters; and a range of cables specially adapted for the same purpose.

In so far as aircraft factories are concerned, the G.E.C. has been responsible for much of the installation on the electrical side, including the "Osira" electric discharge lamp.

129 GAMBRELLS, ROWSE AND SNOADEN, LTD., of 3, St. James's Square, London, S.W.1, are contractors to the Air Ministry for the manufacture of aircraft and aerodrome wireless apparatus. The Company is also supplying modern ground station radio equipment of its own design and is in a position to meet the majority of present-day requirements for civil and military aerodromes, including telegraph and/or telephone transmitters, medium wave, short wave, or combined, up to 5-kW rating; receivers of the most modern and selective type; direction-finding equipment; complete aerodrome transmitting and receiving stations, locally or remotely controlled; and mobile transmitting and receiving tsations, mounted in lorries or trailers.

130 GALLAY, LTD., 103-5-7-9, Scrubs Lane, London, N.W.10, will be exhibiting at the Paris Show, and their products will be well represented by the exhibits, which will be as follows: (1) *Aircraft Radiators and Sections*: A sample aircraft radiator will be shown and also samples of cooling elements ranging from 200 mm. to 600 mm. deep. It is stated that Gallay radiators made under cooling system "E" (chemical) have recently been proved in flight on the latest type of aeroplanes to show definitely less drag while cooling efficiency is much greater.

Oil Coolers: The Gallay dual-stage system, it is claimed, eliminates the possibility of congelation when a long and rapid descent is made under winter conditions.

Cabin Heaters: An extensive study has been made of methods of heating cockpits and cabins and Gallay are exhibiting their combined oil cooler and cockpit heater, and also various designs of cabin heating by means of a steam boiler system similar to the Douglas method.

Tanks: Magnesium and duralumin light alloy tanks are shown, constructed under the special Gallay system of riveting which, in event of damage, enables repairs to be expeditiously carried out.

The Company express their willingness to assist Paris Show visitors with any advice required, as a result of language difficulties, etc., in regard to the Show exhibits generally.

131 W. H. DORMAN AND CO., LTD., Foregate Street, Stafford, manufacture the Constantinesco fire control gear for the operation of aircraft guns.

As readers know, this equipment provides a means of synchronising fixed guns so that they can be fired through the arc of rotation of the airscrew without the bullet striking the blade.

They have the sole manufacturing rights for the latest equipment in this country (excluding Air Ministry requirements).

132 DOCKER BROS., Rotton Park Street, Ladywood, Birmingham, 16, supply aeroplane dope in accordance with the approved scheme D.5CS for adverse weather conditions suitable for brush or spray. In addition to dopes, dope coverings and identification colours can be supplied conforming with D.102, 2D.103, and D.105.

For the fixation of Maddapolam and tape to either wood or metal, there is an adhesive cement which gives greater adhesion than dope, with considerable reduction in weight. Gliders are catered for by a special "two-coat scheme" clear glider dope. Pigmented oil varnishes (DTD.62A), "Syntho-

lux" synthetic lacquers and varnishes (DTD.260), cellulose lacquer (DTD.63), and "Thermolux" low-temperature stoving enamels (DTD.235) can be supplied in all colours.

Airscrew finishes consist of undercoating and finishing varnishes (2X8 and 2X12), cellulose lacquer (DTD.103), matt black cellulose, transparent wood filler (2X11), and undercoating grey paint (X.16).

Varnishes are supplied suitable for external (3X6) and internal (3X7) woodwork, for internal protection of drinking-water tanks (DTD.234), for seaplanes (2X17), and priming (2X14). There is also the shellac varnish (X.18).

Paints are manufactured to resist acid (X.19), dope (3X4), and oil and petrol (4X2), aluminium paint (X.22), paint for pipe lines (X.25).

133 DESOUTTER BROS., LTD., of The Hyde, London, N.W.9, are pioneers of lightweight portable tools specially adapted for the requirements of the aircraft industry.

Four tools stand out as being specially useful to aircraft constructors. These are the pneumatic rotor drill gun, with a speed of 13,000 r.p.m. and a capacity of 3/16 in.; the electric drill gun, with a speed of 5,000 r.p.m. and a capacity of 3/16 in.; the pneumatic rotor corner drill with a speed of 2,100 r.p.m., and the electric corner drill with a speed of 2,500 or 5,000 r.p.m.

All these tools weigh 2½ to 3 lb. only, and by reason of this fact, coupled with their short overall length, small volume, and small frontal area, are ideal for restricted space.

The pneumatic rotor drill guns, with speeds rising from 1,000 to 13,000 r.p.m., and with capacities from 3/16 in. to ⅜ in., consume only 11 cubic feet of free air per minute. The electric drill gun, with speeds of 2,500 r.p.m. and with capacities from 3/16 in. to 5/16 in. in steel and 3/16 in. to 7/16 in. in wood, are supplied in all standard voltages. Despite their size, these tools will produce ¼ in. holes in ¼ in. mild steel in under five seconds. The electric corner drill has speeds of 2,500 or 5,000 r.p.m., and is equipped with a right-angle spindle designed to take collet-type chucks accommodating drills from 1/32 in. to ¼ in. diameter Whitworth. The pneumatic rotor corner drill with a speed of 2,100 r.p.m. has a right-angle spindle fitted with a Collet-type chuck accommodating drills from 1/32 in. to ¼ in. diameter Whitworth.

This firm also manufacture a wide range of air grinders, air spanners, screw guns, nut runners, heavy portable and bench-type electric drills and grinders, etc.

134 V. W. DERRINGTON, 159, London Road, Kingston-on-Thames, is specialising in the manufacture of quick-acting filler caps for aeroplane use, and on engine manifolds, exhaust pipes, and silencers, of which the firm has had considerable experience extending over a period of years.

The filler cap most suitable for aircraft use is the Bonora, this being available in lightweight silicon alloy, which is unaffected by air or water. It has instantaneous operation and is made in various sizes.

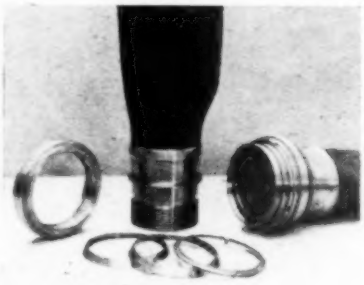
In addition to sheet steel manifolds and light gauge tubular steel exhaust pipes, Derrington's also make a special aircraft silencer which is streamline in form for minimum head resistance, the exhaust gases being quietened on the spiral extractor principle, this being assisted by a venturi-shaped fish-tail. Experiments have shown that the power loss with this silencer only amounts to between 2 and 3 per cent. A 150 h.p. type, 3 ft 3 in. in length, weighs 6½ lb.

Derringtons also handle the Burgess and Servais straight-through silencers for aircraft use, these being available in both mild steel and stainless steel.

135 H. H. COOKE AND SONS, NOTTINGHAM, LTD., Crocus Street, Nottingham, number among their aircraft products cowlings, air intakes, fairings, exhaust manifolds, tanks, sheet-metal pressings, etc.

136 J. B. STONE AND CO., LTD., Chiswell House, 135, Finsbury Pavement, London, E.C.2.—Extensively used in the industry, this firm's nibbling machines are made in three major sizes. As most people know these machines are designed for the purpose of cutting either original or duplicate shapes of all kinds from sheet metal and each consists briefly of a rapidly moving circular punch operating over a similarly shaped die, a small bite being taken out with each stroke, leaving a comparatively smooth edge which requires very little finishing.

The smallest model is intended primarily for use as a bench machine to cut mild steel up to a thickness of 3/32in. while the largest will cut the same type of material up to a thickness of 5/16in. at a rate of thirty inches a minute. The firm also, of course, supplies the necessary punches and dies for their machines.



Root of blade made by the Airscrew Co. for a Rolls-Royce Hele-Shaw variable-pitch airscrew. (162)

137 TRANSRECEIVERS, LTD., 444, Ewell Road, Surbiton, Surrey.—It is an interesting fact that, generally speaking, the shorter the wave used in radio work the more compact can be the equipment. This company specialises in ultra-short-wave combined transmitters and receivers which are both light and simple to operate. The change-over from transmission to reception is effected by a lever type switch, and all models are supplied with a short collapsible aerial as well as the necessary batteries, headphones, and so on. The equipment can be fitted with a locking device on the tuning control so that this can be set once transmission has been tuned in.

The wavelengths used are between 2½ and 4½ metres, and the range is up to 30 miles according to the type of country, remembering that these short waves have much the same characteristics as those of light. Two models have passed the Air Ministry airworthiness tests.

138 THE SPERRY GYROSCOPE CO., LTD., Great West Road, Brentford, London. At the Paris exhibition this company will be showing their very well-known artificial horizon and directional gyro instruments, which are almost universally used in transport machines. These instruments can be obtained in various forms, either, for instance, as a complete panel which is flexibly mounted, or the directional gyro may be supplied alone with a ball bank-indicator for use in smaller machines.

In addition, of course, the Sperry company produces an automatic pilot which has been in successful use for a number of years and is, as a matter of fact, being fitted to each of the Short Empire boats. In these machines a separate gyro and horizon panel is fitted, but the Gyropilot panel also incorporates these two instruments which are, so to speak, the "brains" of the instrument and against which the desired movements of the machine can be set.

139 VOKES, LTD., 95-105, Lower Richmond Road, London, S.W.15.—Although primarily interested in silencing systems for aircraft engines, this firm has more recently entered the market with special air filters and these are, it is understood, the only filters which have received the full approval of the Air Ministry. These filters have as their principle either the Vokes Protectomotor or gauze media in five-, three- or two-ply sections, these being composed of woven fabric and gauze. It is possible to arrange the filters to suit the contour of a cowling so that there is no extra air resistance.

Vokes silencers are of the venturi type in which a deflecting plate whirls the escaping gas tangentially round the inside of a tapered cone, which is drilled with a number of large holes. When the gas reaches the small end of the cone its velocity tends to draw the gas from the surrounding space, which also acts as an equalising chamber for the exhaust impulses. Between the cone and the outer case, and in the centre of the cone, vacuums are created, so absorbing sound.

140 SAMUEL FOX AND CO., LTD., Stocksbridge, Sheffield (Associated with the United Steel Companies, Ltd.).—The special steel production of the United Steel Companies is concentrated in the works of Samuel Fox and Co., where particular attention is paid to meeting the need of the aeronautical industry. The steel-making plant consists of five Siemens Martin open-hearth furnaces and a battery of high-frequency electric induction furnaces ranging in capacity from 5 cwt. to 5 tons.

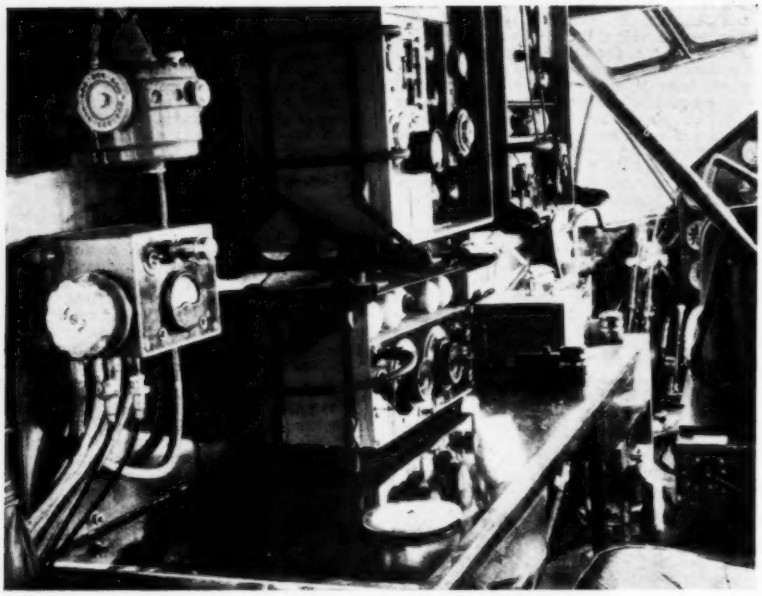
In high-frequency melting there is no contamination by furnace gases, nor is there localised application of intense heat. In order that there may be a positive check on quality the very stringent "Diamet" inspection system has been devised. Under this system the steel is carefully controlled from the assembly of the original charge to the testing and despatch of the finished billet or bar.

Samuel Fox and Co. are well equipped with rolling mills for the production of billets and bars, and they are in regular and close contact with the drop stampers who manipulate their aero-steels. In addition, they specialise in the production of the higher qualities of wire and aircraft strip. The "Silver Fox" range of stainless steel is available in all forms.

141 STERNOL, LTD., Royal London House, Finsbury Square, London, E.C.2.—The products of this firm include Aero Sternol D.T.D.109, as supplied to the Royal Air Force; anti-freezing oil D.T.D.44B, for the lubrication of controls, machine guns, etc.; anti-freezing grease D.T.D.143a; "Protexon" rust preventative D.T.D.121C; Sternoclease (a soft antiseptic paste which protects the hands against dirt, grease, etc.); three varieties of cutting oils; and two of quenching oils.

142 SIR ISAAC PITMAN AND SONS, LTD., Parker Street, Kingsway, London, W.C.2.—This firm of publishers continues to pour forth a stream of reliable books on aviation and aeronautical engineering. Their latest list includes not only such basic and essential works for students and practical men as the "Handbook of Aeronautics," "Introduction to Aeronautical Engineering," and the "Ground Engineers' Textbooks," but also a wide selection of books dealing with every aspect of aviation, including the very latest developments. One of the most interesting of their recent publications is "Small Two-Stroke Aero Engines" (soon to be followed by a companion volume, "Small Four-Stroke Aero Engines").

"Airport Management," by Major L. F. Richard, is another very timely and valuable work. New books for technical workers and students include "Rigging and Airframes," "The Construction of Wooden Aircraft," "How to Build Flying Boat Hulls and Seaplane Floats," "Practical Aircraft Stress Analysis," and many others, including a new edition of the very useful "International Index to Aeronautical Technical Reports."



The interior of the D.H. Dragon which carries more than fifty instruments marketed by Smith's Aircraft Instruments. In the foreground is the Standard radio compass. (153)

143 CAMBRIDGE INSTRUMENT CO., LTD., 45, Grosvenor Place, London, S.W.1.—The Cambridge aero-mixture indicator is a dashboard instrument which continuously analyses the exhaust gas from the engine and shows the result of this analysis on a scale calibrated in air-fuel ratio over a range of from 10 to 15. From its readings the pilot is able to tell at a glance the combustion conditions in the engine, so that he may adjust the mixture ratio to give the most efficient running under the varying conditions of flight.

The value of the Cambridge indicator is not, however, exhausted by its most obvious use as a guide for adjusting the mixture control. It operates as a warning signal by indicating any change in the mixture strength due to variations in the conditions under which the engine is operating, e.g., a change in throttle position, in carburettor air temperature or scoop pressure, in altitude, or a drop in the fuel supply pressure. The instrument also indicates detonation by a fluctuation of the pointer followed by a slow movement toward the rich end of the scale.

144 ANGLO-AMERICAN OIL CO., LTD., 36, Queen Anne's Gate, London, S.W.1, are distributors of Stanavo aviation fuels and oils throughout Great Britain and Northern Ireland and are thus linked with the world-wide organisation of Stanavo. In this country they are able to supply spirit to meet all types of specification. The Stanavo organisation, it is stated, were the pioneers of 100-octane fuel, and have already distributed supplies to consumers all over the world.

At Croydon they have a depot and an organisation for expert and immediate refuelling of the numerous airlines which use their products. Abroad there is the Stanavo organisation supplying fuel to definite specifications of high quality.

In order to help the air traveller abroad it is possible to obtain a Stanavo carnet which will enable pilots to get their fuel and oil supplies on credit terms.

145 SILVERTOWN LUBRICANTS, LTD., London, E.16.—Both Speedolene aero oil and Silvertown P.4 aero oil meet the Air Ministry specification D.T.D. 109 and have had considerable Service use. For the third consecutive year P.4 has constituted the largest proportion of the requirements of the Service, and one or other of the oils are used by the air forces of many countries.

Non-freezing oil to Air Ministry specification and cutting oil (soluble and insoluble), hardening and grinding oil, plant oils, rust preventives and greases are also supplied by this firm.

146 RUBERY, OWEN AND CO., LTD., Darlaston, South Staffs.—It is now twenty-six years since Rubery, Owen started to manufacture aircraft components, and at the present time the firm is, of course, busier than ever. They specialise in pressed and structural steel work and in all forms of steel storage equipment such as is so essential for modern works and aerodrome buildings. In addition, they manufacture steel bolts and nuts, and can produce turned parts in any type of material. The firm's work in the world of heavy structural engineering is probably better known than any.

147 ROTHERHAM AND SONS, LTD., Coventry.—In addition to fuel and oil line details such as unions, taps, filler caps and solderless gauze strainers, this firm also produces a mechanical air pump in which the working parts are completely enclosed. This is adjustable for pressure and can be set to give any in a range between 1 and 10 lb./sq. in. It is, of course, rotary driven, and the lubrication is so arranged that one filling of oil lasts for two days.

148 ROTAX, LTD., Willesden Junction, London, N.W.10.—The number of accessories, from magnetos to engine starters and landing lights, which are made by this firm is very extensive indeed, and it is only possible to pick out a few of the more interesting modern developments.

Of these there is the small electric motor designed for the operation of retractable undercarriages, gun turrets and wing flaps, or for driving small pumps in hydraulic systems. The interesting flaps of the Short Empire boat, incidentally, are operated by these motors, and Rotax equipment generally plays quite a large part in the electrical system of these machines. This firm also makes inertia starters, both of the hand and electrically operated type, as well as rotary transformers, voltage control boxes and solenoid switches. A more recent series of productions are adjustable reflectors for landing lights, cabin lamps, dash lamps, and approved navigation lights.

149 SILENTBLOC, LTD., Victoria Gardens, Ladbroke Road, London, W.11.—It was to be expected that the Silentbloc principle, so well known in the world of ground transport, would eventually be applied to aircraft for various purposes. Among the special accessories produced by this firm for this specific purpose are anti-vibration mountings for panels and for separate instruments, cushion mountings for power units, and similar mountings for all manner of industrial purposes.

The Silentbloc principle is a very simple one and overcomes most of the difficulties concerned with the employment of plain rubber pads. The outer shell of the mounting is a pressing with a cylinder of stretched rubber between this and a steel sleeve, so that in addition to any other advantages, there can be complete electrical insulation between the engine and its supports.

150 SHORT AND MASON, LTD., Macdonald Road, Walthamstow, London, E.17.—A very representative range of aircraft instruments, test apparatus and barographs will be shown by this firm at the Paris Exhibition. Included among them are the well-known Sestrel compasses, Brown turn and bank indicators, special meteorological instruments such as micro-barographs, thermographs, hygrographs, thermometers, meteorographs, and more specialised instruments such as the Robinson anemometer and the Fortins standard barometer.

Several very interesting instruments are, we understand, coming along in the works of this company, who are always prepared to manufacture any precision instrument or testing device to the order of a customer.

151 G. O. SALTER AND CO., LTD., West Bromwich.—Makers of all types of weighing machines, gauges, testing machines, and so on, this firm is probably better known for its springs, of the manufacture of which it has probably had a wider experience than any other firm in the country. The firm was established as long ago as 1760, and actually made undercarriage springs for the first machine to fly in England.

152 YOUNG WINDOWS, Claydon Works, Mill Road, Wishaw, Scotland.—As their name implies, this firm specialises in various types of windows and supplies a particular kind especially suitable for use in aircraft. This is of the constant-balance type and can be supplied either complete or as a fitting only. The construction incorporates a patent balance system of cam compensation to carry varying weights of window within a certain range, so that the window will remain firmly in any position in which it is left without the necessity for locking devices. The compensation can, however, be arranged so that the window is quietly self-closing.

This Derrington aircraft silencer has a venturi action. (134)

Indices to the equipment described in this section, and to the names of firms, will be found on page 535.

153 SMITHS' AIRCRAFT INSTRUMENTS, LTD., Cricklewood Works, London, N.W.2.—It would be quite impossible to describe or even to enumerate every one of the many instruments and details of equipment which are handled by this firm. Among many other accessories which are being shown at their stand at the Paris Show are a complete instrument panel, a new blind-flying panel, Standard radio equipment, Harley landing lamp, Husun compasses and navigational computors.

The Standard radio range has already been described under heading No. 24. Additionally, the exhibit will include examples of Petroflex tubing and fittings, a range of K.L.G. plugs, Essex fire extinguishers (dealt with in Section 59), Frazer-Nash enclosed wing-tip flares, and electrical fuel level indicator equipment. The last operates on a very simple principle, involving a light tank unit with an electrical resistance built into Bakelite mouldings, and a dash indicator so arranged that the pointer takes up a position which depends, of course, upon the distribution of resistance between the tank unit terminals. By the use of multi-way switches several tank levels can be registered on one indicator in order to save space.

154 WEATHERSHIELDS, LTD., 48, Moor Street, Birmingham, 4.—In addition to carrying out presswork and welding for the industry, this company also manufactures windscreens and special sliding roofs for loading cargo or for pilots' compartments so that the crew can obtain a better view of the surrounding objects while manœuvring on an aerodrome and can also leave the machine more readily after a possible forced landing. These roofs have already been fitted to a number of machines.

155 WOODS, SONS AND CO., 6, Milk Street, E.C.2.—Manufacturers of aircraft fabric, tape and webbing, this company also supplies flexible steel wire ribs and hemp lines, and do work of this kind for every British aircraft manufacturer. All the materials are to Air Ministry specifications.

156 WRIGHTWAYS, LTD., Airport of London, Croydon, Surrey. — Considerable extensions and modifications are being made to the premises of this company at Croydon Airport, and until these are actually equipped with the special machinery which is now on order, it is not possible to say very much about their future activities. Wrightways have taken over the hangar formerly occupied by Cirrus Hermes, Ltd., and are continuing the repairs and maintenance department on a larger scale. Further details of their present activities appear in the commercial aviation pages of this issue.

157 Y.S.C., LTD., 13, Thavies Inn, Holborn Circus, London, E.C.1.—The Holt type of flare is sufficiently well known to require no introduction, and this firm supplies both the flares, the necessary brackets and shields to suit different machines, and general pyrotechnics for use both by pilots and ground staff at aerodromes. The fittings in the case of flares are quickly detachable so that they can be removed from the wing of training machines when night flying is not being carried out. The H.7 type of flare gives 30,000 candlepower in comparison with the 8,000 of the older approved type 21.

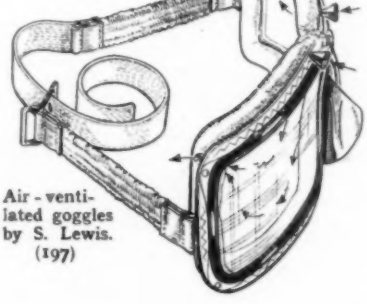
158 VICKERS (AVIATION), LTD., Vickers House, Broadway, Westminster, London, S.W.1.—The range of aircraft accessories produced by this company is a very complete one and is liable to be forgotten by the ordinary person who thinks only in terms of complete aeroplanes. These accessories include such things as fuel cocks and pumps, filters, flow indicators, oil coolers and universal pulleys.

The interior of Airwork's big maintenance hangar at Heston. (200)

The company has recently introduced a very interesting self-locking nut of the anchor type, which is machined out of one piece of metal and requires no accessories or insertions. The body is that of an ordinary nut with the height extended to form a sprung portion. Following the initial tapping and vertical slotting, a special process is applied to ensure that an adequate spring grip is maintained over the full thread surface of this portion. Practical tests have shown that after a hundred complete reversals there was no deterioration in the locking efficiency.

159 GEO. TUCKER EYELET CO., LTD., Cuckoo Road, Birmingham, 7.—Specialists in modern methods of riveting, this company's range of rivets covers the cup, capped cup and pop types made from mild steel, stainless steel, aluminium alloy and nickel alloy. The first type has a solid end and is easily handled; the second type is similar but has a cap over the rim, the idea being to incorporate all the advantages of a hollow rivet and yet present the appearance of one of the solid variety where a streamlined surface is concerned.

The main advantage of the pop rivet is that it can be used where only one end is accessible. The Tucker Eyelet type is set with a deformable mandrel, so that while this is being withdrawn it has the effect of stretching the rivet to fill the hole when the latter has been drilled oversize. All rivets are made in a variety of sizes.



Air-ventilated goggles by S. Lewis. (197)

160 BROOKLANDS AVIATION, LTD., Brooklands Aerodrome, Surrey.—Until the recent and unfortunate fire which occurred at Brooklands, this firm was carrying out as much maintenance and overhaul work, particularly on engines, as any in the country. Presumably, the shops will soon be in full working order again, and in the meantime the school and sales side of the business is carried on as well as possible in the circumstances.

161 COMPER AND WALKER, LTD., 86, Strand, London, W.C.2.—As aeronautical consultants this firm handles all aviation matters of a technical, advisory and commercial nature, but it is also now fully equipped with a drawing office and design staff. It is therefore in a position to offer service to aircraft manufacturers and private owners by contracting for initial design work of new types, and also the complete designing and production of special aircraft either for competition or general use.

162 THE AIRSCREW CO., LTD., Weybridge, Surrey, in addition to designing and manufacturing very large quantities of ordinary wooden airscrews, hold the British licence for treating wooden blades by the Schwarz process, whereby a coating of weather-resisting material is forced into the pores of the wood under pneumatic pressure. Detachable wooden blades are also manufactured for three-bladed airscrews, the roots of which are held in a metal sleeve. The detachable blades can, of course, be set to any desired pitch while the airscrew is stationary.

Blades for variable-pitch airscrews are also manufactured and treated in accordance with the Schwarz method, and a photograph on page 529 shows the root of such a blade. In the foreground are seen the pre-loading rings used for putting an initial load on the ball race, equal and opposite to that due to centrifugal force. Thus, when the airscrew is running, the bearings are free, and but a small force is required for changing pitch.

163 RANSOME AND MARLES BEARING CO., LTD., Newark-on-Trent. —Specialists in the manufacture of ball and roller bearings, this firm now manufactures a special range of high-speed bearings, with

duralumin cages, which are employed in the majority of superchargers manufactured in this country. These are designed to run at speeds of over 30,000 r.p.m., and in some instances the bore of the bearing is as much as 2¼ in. In addition, they supply heavy-duty roller bearings, and special ball bearings for use on V.P. airscrews, to the De Havilland Company.

Ransome and Marles are now making a special series of ultra-light ball-journal bearings, made either of rustless steel or cadmium plated steel, for use in control systems. This firm's bearings were, as a matter of fact, used in the engine, the supercharger and the controls of the altitude-record machine built by the Bristol company, and have for a number of years been fitted as standard to all Bristol engines.

164 ROLLASON AIRCRAFT SERVICES, LTD., Airport of London, Croydon, Surrey. Well known for their work as maintenance and overhaul engineers at both Croydon and Hanworth, this firm also manufactures cowlings, fuel tanks, undercarriage components, and metal aircraft fittings of every description. "Rollasons" have actually designed and manufactured many special parts and electrical equipment for various customers, and, in the ordinary course of events, build up any type of wooden aeroplane. They are sub-contractors to Vickers-Supermarine, Percivals, and Armstrong Whitworths.

165 REID AND SIGRIST, LTD., Shannon Corner, New Malden, Surrey.—Pioneers in the design and manufacture of the turn indicator as we know it at present, this firm has also developed a combined turn and lateral level indicator known as the Gyorizon. By the simple expedient of extending the turn needle, adding a pair of "wings" to it, and arranging for a visible liquid lateral horizon in the dial immediately behind, the firm has produced an instrument which, while providing all the essential indications in a fairly easily understood form, may also be used for flying in all possible attitudes, including the inverted position.

With either the standard turn indicator or the Gyorizon it is usual to fit a fore and aft level or pitch indicator, and that produced by R. and S. is one of the best-known examples.

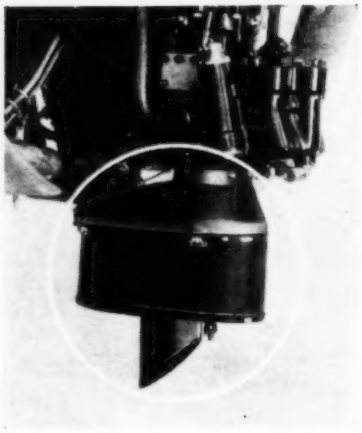
166 R.F.D. CO., LTD., Stoke Road, Guildford, Surrey.—Probably the largest firm to manufacture such life-saving apparatus as flotation gear and collapsible dinghies, the R.F.D. Company also manufactures balloons, flag and drogue targets, wind socks, sea-drogue targets, mooring and towing gear for seaplanes, and similar items of equipment. They are on the Air Ministry, War Office, and Admiralty lists.

167 PAK PARACHUTE CO., LTD., 175a, Streatham Road, Mitcham, Surrey.—Parachutes of all kinds, whether for life-saving, supply dropping or flare-dropping, as well as many types of towing targets, are made by this company.

The latest type of Pak parachute, known as the Universal, is one which, with its harness, can be used either as a detachable, seat or back type. The chief pilot can therefore vacate his seat, leaving the parachute in position for a relieving pilot, and the former can bring his hooks to the front and then use any other pack available in the machine.

168 PETO AND RADFORD, LTD., 50, Grosvenor Gardens, London, S.W.1.—The outcome of more than fifty years' experience in battery manufacture, Dagenite accumulators are available in four different types, a particular feature being their ability to withstand, when necessary, a very high rate of discharge. This is particularly useful nowadays with the tendency for designers to use electric motors for operating such things as undercarriages and flaps in addition to engine starters.

Two of the ranges are of the unspillable



The Vokes air filter in place on a carburetter. (139)

variety and are fitted with the Davis vent. The third range has been evolved to meet the somewhat heavier requirements of large civil types, which are not likely to engage in aerobatics. The fourth range has been designed for very heavy duty, such as is applied when starting machines on the ground from a mobile unit.

169 AVIATION DEVELOPMENTS, LTD., Argyle House, 29/31, Euston Road, London, N.W.1.—This company has been brought into being to acquire and to exploit the British, Dominion, and Colonial rights for patents concerned with aircraft design and production. It has already acquired the exclusive rights for the allied Chobert patents, among which the special system of riveting has already been dealt with in *Flight*. On the board of this company are such well-known people as Sir Alliott Verdon-Roe and Group Capt. V. Bettington, while as technical consultants they have Group Capt. W. H. Primrose and Mr. T. C. L. Westbrook.

170 PORTSMOUTH, SOUTHSEA AND ISLE OF WIGHT AVIATION, LTD., The Airport, Portsmouth.—Better known, perhaps, as operators of an air ferry service between the mainland and the Isle of Wight, which has been running now for two or three years, this company does, particularly in the winter months, a very considerable amount of maintenance and overhaul work. They have recently entered into a contract for the lease of part of the hangar and the exclusive maintenance rights at Weston, and are maintaining the entire fleet of Western Airways. An associated company, Vectis Airports, Ltd., own Ryde Airport and are very busy there.

171 PLASTILUME PRODUCTS, Humes Avenue, Boston Road, Hanwell, London, W.7.—Experienced in the moulding of acetate and similar materials into forms which are used in the industry, this firm makes the material for such fittings as windscreens, cabin tops, windows, and gun turrets. As far as opaque materials are concerned, they make fairings of all descriptions, and these are sometimes treated for protection against sea water. The processes involved in this moulding work have been accepted by the Air Ministry and are patented in all the more important countries.

172 THE PHOSPHOR BRONZE CO., LTD., Sumner Street, London, S.E.1.—As its name implies, this company specialises in phosphor bronze alloys for gears and bearings, and also produce white anti-friction metal, which has been very successful in a number of aircraft engines. Aluminium bronze in castings, drawn rod and rolled sheet are also products which are extensively used in engine manufacture.

173 SURREY FLYING SERVICES, LTD., Croydon Airport, Surrey.—Although primarily interested in charter flying work, instruction, and in the sale of machines, including a number of interesting American types, such as the Cessna and Beechcraft, "Surrey's" also carry out quite a lot of maintenance and repair work at Croydon, where they were among the pioneer tenants.

174 RADIO TRANSMISSION EQUIPMENT, LTD., Charing Cross Road, London, W.C.2.—The sales organisation for the well-known firm of Plessey, R.T.E. supply two-way short- and long-wave radio sets, ground D/F station equipment and homing receivers for the lighter types of aeroplane where heavier two-way equipment can neither be carried nor operated.

175 A.B.C. MOTORS, LTD., Walton-on-Thames, Surrey.—A 4 h.p. flat-twin engine intended for installation in large aircraft is built by A.B.C. Motors. This useful little unit will not only operate an air compressor, but will also drive three or four other units.

176 ACCLES AND POLLOCK, LTD., Oldbury, Birmingham.—This old-established firm of tubing specialists can supply almost any variety of tubing in round, streamline, oval, square and special sections for aircraft work.

177 ADAMANT ENGINEERING CO., LTD., Dallow Road, Luton, Beds, manufacture aircraft components to order, their work including sheet-metal construction and autogenous welding. Their works' equipment includes heat-treatment furnaces and sand blasting, anodic, cadmium-plating and painting plant.

178 AIRSPARES, LTD., Eagle House, Jermyn Street, London, S.W.1.—As well as their business of aviation consultants, this firm acts as agents for new and second-hand aircraft and runs a specialised service for quick delivery of all aircraft spares.

179 BROWN BROS., LTD., Gt. Eastern Street, London, E.C.2.—The vast stocks of aircraft material held by Brown Bros. include A.G.S. parts and bolts and nuts in mild, high-tensile and stainless steels and light alloy; pipe-line fittings of all descriptions; electrical bonding and screening fittings; flexible steel wire ropes, turnbuckles, etc.; streamline wires and swaged tie-rods; solid and tubular rivets; washers of all descriptions; rubber shock-absorber cord and end fittings; linen fabric and tapes, sewing thread, and sundries; glues and casein cement; solders; special machined parts in all metals; repetition work from bar, forgings and stampings; samples of mild steels, high-tensile and stainless steels to British Standard Specifications S.1, S.2, S.6, S.11, S.14, S.61 and S.80.

180 AIRCRAFT GENERAL SUPPLIES, LTD., London Air Park, Feltham, Middlesex.—As related recently in *Flight*, a large warehouse has been established at Hanworth for material and A.G.S. parts, from which immediate delivery can be given. The company's steel-tubing section is stocked with a wide range of material and a floating stock of over 10,000 gross of bolts is to be maintained.

181 MORRIS AND INGRAM, 26, Finsbury Square, London, E.C.2.—Among the workshop equipment marketed by Morris and Ingram the "Sioux" metal spray gun is of particular interest in view of its use for spraying components with soft non-oxydising metals. Fabric may also be treated in the same way, because the gun sprays metal in such a manner that when it reaches the object it is quite cold.

Other products include the Hall eccentric valve seat grinder, the grinding element of which traverses round the seat in the manner of a cylinder hone; examples are used by

Indices to the equipment described in this section, and to the names of firms, will be found on page 535

Imperial Airways. There is also the "Sioux" valve re-facing machine, the Hall valve seat inserting press, Hall cylinder hones, and a hone for gudgeon-pin holes.

182 K.L.G. SPARKING PLUGS, LTD., Putney Vale, London, S.W.15.—These famous sparking plugs, to which the aviation world needs no introduction, have played a part in a great many record flights, including those recently made by Miss Batten, Mrs. Mollison and Mr. C. W. A. Scott, not forgetting Sqn. Ldr. Swain's altitude record. They are made in a range of 12, 14 and 18 mm. sizes to meet all aero engine requirements, and there is also a selection of radio-screened types.

In addition to plugs themselves the firm makes a range of sparking plug maintenance and testing equipment. K.L.G. plugs will be exhibited at the Paris Show, on the stand of Smith's Aircraft Instruments.

183 THE FAIREY AVIATION CO., LTD., Hayes, Middlesex.—As is well known, this well-known firm of aircraft constructors also makes Fairey metal airscrews in a variety of patterns. Among these may be mentioned two- and three-bladed C.P. airscrews, hydraulically operated, fixed-pitch three-bladed airscrews, and a two-bladed type made from a single flat forged blank of light alloy.

184 COOKE, TROUGHTON AND SIMMS, LTD., Buckingham Works, York.—Products which are of chief interest to the aircraft industry are the Vickers projection microscope, Vickers contour projector and the Cooke optical comparator. The first-named instrument is capable of dealing with specimens of up to 50 lb. in weight without fear of damage, and so should be particularly valuable for examination of castings. The second, by projecting in a greatly enlarged size the contour of the specimen placed in it, is of particular value in maintaining a check on the wear of such workshop tools as taps and dies, together with jigs and templates. The optical comparator is chiefly used for the rapid and accurate checking of parts produced in quantities.

185 FEENY AND JOHNSON, LTD., 134-136, Ealing Road, Wembley, Middlesex.—Although water cooling is not widely employed on aircraft nowadays, there are quite a number of applications of the "F. and J." universal hose clip, which will fit any size of hose and secure it with a strong and even pressure.

186 THE CARDIFF FOUNDRY AND ENGINEERING CO., LTD., Hurman Street, Cardiff.—The ingenious feature of the "Pillar of Fire" aerodrome boundary light is the fact that it will collapse immediately, without damage, should it be struck by an aircraft, the current at the same time being positively cut off by a safety switch. The lighted beacon is very clearly distinguishable, being surmounted by the regulation orange light and showing a brilliant red-orange light on the pillar itself.

These beacons are installed at Doncaster and Cardiff and a demonstration model has been erected at Heston airport, by Malcolm and Farquharson, Ltd., who hold the sole agency.

187 SIMMS MOTOR UNITS, LTD., Oak Lane, East Finchley, London, N.2.—The products of this company include the Simms patent flexible magneto and dynamo couplings, petrol filters; magnetic fuel level indicators, oil pressure gauges, and magnetic oil filters for picking up ferrous impurities in engine sumps and oil pipe lines.

An interesting point is that Mr. C. W. A. Scott's Percival Gull which won the Johannesburg Race had a Simms vernier magneto coupling in its Gipsy engine.

188 E. G. BROWN AND CO., LTD., West Road, London, N.17.—Among the many components produced by these presswork specialists may be mentioned air intakes, exhaust manifolds, cowlings and engine fairings, aircraft seats, nose cowls, fuel tanks, spats and general sheet metal work.

De Bergue riveted tanks are made with a capacity up to 325 gallons and oil tanks up to 116 gallons. Special machinery and heat treatment plant have been installed for this process. Recent additions to plant and equipment will enlarge the scope of the firm's operations.

189 MALCOLM AND FARQUHARSON, LTD., Heston Airport, Hounslow, Middlesex.—This well-known firm of aircraft agents also handles certain other equipment, among which may be mentioned the "Pillar of Fire" boundary light referred to in paragraph 186 of this review.

190 TITANINE, LTD., Colindale, London, N.W.9.—Specialists in aircraft finishes for the last twenty-one years, this firm produces Titanine dope, which enjoys a world-wide reputation. During this period they have developed and perfected schemes for the coating of fabric and plywood which are exemplified on practically all the civil aircraft produced in this country and on many built abroad.

By research on corrosion resistance they have anticipated the development of all-metal construction, so that now, on the eve of considerable production of this type of machine, they have finishes to meet all requirements. These include "Lumilac" synthetic finishes and special schemes for magnesium alloy and flush riveted skins and the latest matt finishes in cellulose and synthetic lacquers, all to Air Ministry specifications.

Extensions to the firm's Colindale works to meet increased orders have involved extension of the floor space by 50 per cent.

191 GIEVES, LTD., 21, Old Bond Street, London, W.1.—In addition to ordinary clothing and sports wear, together with uniforms and Service equipment generally, Gieves, Ltd., have a range of some hundreds of articles of jewellery incorporating the Royal Air Force badge.

192 ARTHUR L. GIBSON AND CO., LTD., Radnor Works, Strawberry Vale, Twickenham, Middlesex.—The products of this firm consist of Kinnear rolling shutters, which, made in a variety of sizes, have application to aerodrome and factory buildings. An interesting point is that the shutters can be constructed with ventilation grilles.

193 BOWDEN (ENGINEERS) LTD., Willesden Junction, London, N.W.10, specialists in the manufacture of control cables, have recently produced the multi-wire "Bowdenex" conduit, which is finding wide application in the aircraft industry. This control combines the advantages of both the flexible and solid or positive type of control.

The firm also supplies to the aviation industry its wide range of standard levers and fittings, adaptable to a variety of purposes. A new range of double-action levers in magnesium alloy is also worthy of mention.

194 THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, Manchester, offers a wide range of Air Ministry approved batteries for lighting, starting, and radio use. There are also a number of electrical accessories, such as workshop hand lamps and outside repair projectors.

195 BRUNTONS (MUSSELBURGH) LTD., Musselburgh, Scotland.—Specialists in wire and wire cables, this firm manufactures wire and tie rods to streamline and many special sections. There are also a number of complementary fittings, such as fork ends, locking plates, turnbuckles, and locknuts. Most of these fittings are obtainable in stainless steel, and another speciality of the firm is cold rolled stainless steel strip.

196 THE G.Q. PARACHUTE CO., LTD., 17, Stoke Road, Guildford, Surrey.—The G.Q. "Harnasuit" consists of a standard Service type of white twill suit, on the outside of which is fastened a self-adjusting silk parachute harness. An inflatable silk lifebuoy is also included. Large snap hooks on the harness are provided for quick attachment to the G.Q. breast-type parachute.

Another ingenious kit is the G.Q. "Parasuit." The main feature is a frameless flexible pack which enables the back-type G.Q. parachute to be built in very comfortably as part of the flying suit—which, incidentally, can be supplied in any required colour, e.g., for various air forces.

In addition, the G.Q. company makes a full range of orthodox packs and harnesses, the latter embodying an ingenious quick-release mechanism. One particularly interesting model is a very compact parachute for glider pilots; it weighs only 15½ lb. Last, but not least, must be mentioned that particularly ingenious variety of flotation gear, the Youngman Dinghy.

197 S. LEWIS, 27, Carburton Street, London, W.1.—So wide is the range of aviation clothing listed by S. Lewis that it is impossible to detail individual items, but there is an endless variety of flying suits, helmets, etc., which can always be designed if necessary for customer's own requirements.

A particularly wide choice of goggles is stocked, and two new models have recently been introduced. One is a high-speed flying or racing goggle fitted with rubber edges and embodying an air vent to prevent misting of the glass and to secure comfort for the wearer in hot weather. Another is the new square-framed type of Service goggle, as illustrated on page 531. Like the other, it is fitted with an air vent; this is of very small diameter, and distributes the air evenly round the top framework, thus preventing any danger of direct draught on the eyes.

198 THE BENJAMIN ELECTRIC, LTD., Tariff Road, Tottenham, London, N.17.—Reflectors for electric discharge lamps are the product of this firm which will be of most interest to the aircraft industry, since they have wide application for works and hangar lighting. The light is of a very brilliant nature, yet is not tiring to the eyes of those working under it.

199 AVERY EQUIPMENT LTD., The Green, Twickenham, Middlesex, manufacture wheels, brakes, and controls. The Avery brake is entirely enclosed and unaffected by water or grit, and it is impossible for the brake to "seize on." The wheel rim is supported at its extreme edge by the brake casing, thus allowing of much lighter construction and great saving in weight. The brake consists of an anular capsule enclosed between two friction-lined flexible discs. Fluid pressure (air or oil) applied to the capsule forces the discs apart and into frictional engagement with the steel-lined enclosing case, which latter dissipates the heat well away from the tyre tube.

200 AIRWORK LTD., Heston Airport, Middlesex, have completely equipped workshops for major and minor overhaul and repair work on all types of aircraft and engines, fully approved by the Air Ministry, with a special department for the repair of electrical components. There are large and well-stocked stores, engine repair shops, testing sheds complete with Heenan and Froude reversible dynamometer, large sheet-metal shops for production of aircraft tanks and fittings in quantity, anodic plant, and a woodworking plant. Design and experimental work of any description is also carried out.

201 GLEDHILL BROOK TIME RECORDERS, LTD., Empire Works, Huddersfield.—The time recorders made by Gledhill Brook are so well known as to need little introduction to all engaged in industry. Models suitable for works from the smallest to the largest are made

202 J. J. HABERSHON AND SONS, LTD., Holmes Mills, Rotherham.—It is seldom realised how many parts used in aircraft begin life as strip steel, of which every variety is made by Habershons to A.I.D. limits. In addition, sheet steel, finely finished, is a speciality of this famous mills.

203 W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., Holborn Viaduct, London, E.C.1, number among their many products the Solon electric soldering iron, which should find many uses in the aircraft and allied industries. Industrial types are made for supplies of 125 and 240 watts.

204 WILLIAM MILLS, LTD., Grove Street, Birmingham, are responsible for "Aeral" aluminium alloy to specification D.T.D. 294. This material lends itself particularly well for fine machining.

205 MOLLART ENGINEERING CO., Kingston By-Pass, Surbiton, Surrey.—Originally applied in the Autogiro rotor head, the Mollart universal ball joint now has a great many applications in aircraft and aero engine work. It figures in the specification of the Short Empire flying boats.

206 THE NORTHERN RUBBER CO., LTD., Retford, Notts, are responsible for "Nordoil" oil-resisting rings, petrol hose and similar items. This equipment is fitted to the Gipsy engine of Mr. C. W. A. Scott's Vega Gull which won the Johannesburg Race.

207 THE BRITISH ENGRAVING AND NAMEPLATE MFG. CO., 7-8, Charlotte Mews, Tottenham Street, London, W.1.—In view of the vast number of explanatory, instructional and cautionary notices in modern aircraft—particularly military types—the products of this company are of particular interest to the industry. Mr. R. Lansdowne, the proprietor of this business, has had some fifteen years of practical experience in machine and chemical engraving, and some three or four years ago he founded the present firm, which is in a position to give very prompt delivery.

208 ARENS CONTROLS, LTD., Praed Street, London, W.2.—For some years now Arens controls have found extensive use in aircraft, the system being such that positive transmission of quite heavy loads is secured. These controls figure in the specification of new Empire Flying Boats.

209 BOOSEY AND HAWKES, LTD., Deansbrook Road, Edgware, Middlesex.—Pressings in non-ferrous metal, and particularly seamless bends and other awkwardly shaped jobs, are a speciality of this firm, who work to very fine limits.

210 CORK MANUFACTURING CO., LTD., South Chingford, E.4.—Langite jointing has a very high degree of resilience and is stated to make a perfect seal even on unmachined surfaces, a heavy pressure between joint faces being unnecessary. It resists oil, petrol, benzole, acetone, methylated spirits, etc.

211 DE BERGUES PATENTS, LTD., Strangeways Ironworks, Manchester, hold the manufacturing rights of the De Bergue riveting process, in which the metal surrounding each hole is pulled upward into a cup, so that direct shear stresses on the rivet are impossible. The system is particularly popular for aircraft tanks.

212 EN-TOUT-CAS (SYSTON), LTD., Leicester.—This famous firm has for many years specialised in aerodrome preparation, and a number of military and civil aerodromes throughout the country owe their fine surface and efficient drainage to the work of En-Tout-Cas.

213 PALMER TYRE, LTD., Thames House, Millbank, London, S.W.1.—Pioneers in the manufacture of special tyres for aircraft, the company makes a wide range of high- and medium-pressure tyres in both ordinary and streamlined form. There is also an electrically conductive tail wheel.

Equally popular are Palmer aircraft wheel brakes, made in both the pneumatic and hydraulic patterns; simplicity is one of the outstanding features. Various methods of control, by foot and by hand, are applicable and, of course, differential rudder bar action is available.

214 PATENT MOTOR PRODUCTS, LTD., 6, Upper Marylebone Street, London, W.1.—Among the various preparations made by this firm may be mentioned "Hermeticoll," a very efficient jointing compound for engines and other parts.

215 TECHNICAL PLATINGS, LTD., Craigs Works, Luther Road, Teddington.—In addition to all varieties of plating work, this firm has a special anodising plant capable of dealing with tanks of up to 2,000 gallons capacity.

216 TILLEY LAMP CO., Hendon, London, N.W.9.—Specialists for many years in the manufacture of paraffin vapour lamps, the Tilley Lamp Co. has adapted its powerful incandescent mantle projectors for aerodrome floodlighting, the lights being mounted in batteries of three on an easily movable trolley.

217 EDWARD WEBB AND SONS, LTD., Wordsley, Stourbridge.—Experts on the subject of seeding for grass, Edward Webb have closely studied the subject of aerodrome preparation, and have been responsible for the seeding of several important Service aerodromes. The grass usually advised is of a particularly tough-rooted nature which will withstand tearing by tail skids, braked wheels, etc.

218 WORLDWIN PISTONS, LTD., Cyfarthfa Works, Merthyr Tydfil, S. Wales.—The outstanding feature of the Worldwin piston, now being made for aircraft use, is a system of internal construction by which cooling ribs connect the crown and walls.

219 ZWICKY, LTD., Slough, Bucks, specialise in aerodrome refuelling units, a large number of which have been supplied to the Royal Air Force. Certain Zwicky units, mounted on motor chassis, are made in very large capacities. Pumps and complementary equipment are also numbered among this firm's productions.

AVIATION INSURANCE COMPANIES

Aviation and General Insurance Co., Ltd., 33, Lime Street, London, E.C.3.
British Aviation Insurance Co., Ltd., 3/4, Lime Street, London, E.C.3.
L. T. Bulmer (Insurance), Ltd., Bradford, Yorks.

AERONAUTICAL TECHNICAL TRAINING

Airspeed (1934) Ltd., Technical School, Portsmouth Airport.
British Institute of Engineering Technology, 306, Shakespeare House, Stratford Place, London, W.1.
De Havilland Technical School Hatfield, Aerodrome, Herts.
College of Aeronautical Engineering, Brooklands and 102, Sydney Street, London, S.W.3.
Imperial School of Air Navigation, 57c, Nottinghill Gate, London, W.11.
International Correspondence Schools, Dept. 182 Imperial Buildings, Kingsway, London, W.C.2.
London Telegraph Training College, Ltd., 20, Penywern Road, London, S.W.5.
Loughborough College, Loughborough, Leicestershire.
Northampton Polytechnic, St. John Street, London, E.C. 1.
Technological Institute of Great Britain, 37, Temple Bar House, London, E.C.4.

220 TURNERS ASBESTOS CEMENT CO., Trafford Park, Manchester, 17. The combination of Portland cement with asbestos fibre produces a building material which offers many advantages, not least among them being fire-proofness. Roofing, wall material tiling, floors, etc., produced from asbestos-cement are the speciality of this company, which has been responsible for the erection and decoration of a number of aerodrome buildings in various parts of the country.

221 BURBERRY'S, LTD., Haymarket, London, S.W.1, contractors by appointment to the R.A.F. College, Cranwell, make a speciality of uniforms and Service clothing requirements generally.

222 AIR HIRE, LIMITED, Heston Airport, Heston, Middlesex, specialise in hiring out aircraft, generally without pilot. Aircraft may be hired by the day, week, month or the year, to be flown by "A" or "B" licence pilots approved by the company. In the case of the longer periods reduced rates are quoted, inclusive of all costs of running an aeroplane, save only fuel and incidental out-of-pocket expenses.

223 F. J. A. CAMERON, 2, John Street, London, W.1.—Agent for the Grimes retractable landing light in this country, Mr. Cameron has had two of these fitted, for demonstration purposes, on his Leopard. The movement of a single switch both lights the lamp and starts a small electric motor which brings it into position.

224 HERITIER, LTD., Tyburn Road, Erdington, Birmingham, specialise in all types of alloy castings for the aircraft industry. An example is illustrated on page 526.

225 TAW MANUFACTURING CO., LTD., Campsbourne Works, High Street, Hornsey, London, N.8.—Specialists in lamp manufacture, sheet metal work, spinnings and pressings, this company was responsible for certain items of equipment in the Short Empire flying boats, namely, the cabin roof lights and patent detachable wall lights.

226 LINDSAY-NEALE AVIATION CO., 7-8, Norfolk Street, Strand, London, W.C.2.—This firm, acting as an agency, is able to meet almost any aviation requirement, from accessories and components to hangars.

227 AUTO-KLEAN STRAINERS, LTD., 40, Trinity Square, London, E.C.3, manufacture the "Auto Klean" petrol filter, which is used by several leading engine manufacturers, and which has figured in the equipment of many machines successful in races and record attempts. Ease of maintenance is a feature.

228 WILD-BARFIELD ELECTRIC FURNACES, LTD., Electrofurn Works, North Road, Holloway, London, N.7, manufacture electric furnaces for almost every industrial need. A demonstration is at present in progress (concluding tomorrow) at the Manchester Corporation Electricity Department Demonstration Workshop, Dickenson Street, Manchester.

229 BREEZE CORPORATION OF GT. BRITAIN, Vicarage Lane, Ilford, Essex.—The well-known Breeze screening, shielding and bonding equipment and accessories, which have been developed to a very high standard of efficiency in the United States, where they are used on the vast majority of Service and civil aircraft and aircraft engines, are now being manufactured under licence in Europe by this company.

230 JABLO, LTD., Brettenham House, London, W.C.2, holds the rights for the German Heine airscrew, and, as related on page 514, a new company, Ipswich Airscrews, Ltd., has been formed to manufacture it in this country.

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THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS — AIR MINISTRY ANNOUNCEMENTS

CHANGES IN HIGHER COMMAND

The Air Ministry announces the following appointments:—

Air Vice-Marshal Christopher Lloyd Courtney, C.B., C.B.E., D.S.O., to be Air Officer Commanding, British Forces in Iraq, in February, 1937, vice Air Vice-Marshal William Gore Sutherland Mitchell, C.B., C.B.E., D.S.O., M.C., A.F.C.

Air Vice-Marshal Richard Edmund Charles Peirse, C.B., D.S.O., A.F.C., to be Director of Operations and Intelligence, and Deputy Chief of the Air Staff at the Air Ministry, in January, 1937, vice Air Vice-Marshal Christopher Lloyd Courtney, C.B., C.B.E., D.S.O.

ROYAL AIR FORCE DISPLAY, 1937

The eighteenth annual Royal Air Force Display will be held at the R.A.F. Station, Hendon, on Saturday, June 26, 1937.

AIR FORCE LIST

The November issue of the *Air Force List* has now been published. It can be purchased (price 3s.) from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, London, W.C.2; 120, George Street, Edinburgh; 2, York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square, Belfast; or through any bookseller.

ROYAL AIR FORCE GAZETTE

London Gazette, November 3, 1936

General Duties Branch

The following are granted permanent commissions as Pilot Officers with effect from October 19 and with seniority of the dates stated:—J. E. Innes-Crump, L. Vincent (January 19, 1935); P. J. C. Canney, J. R. G. Finlayson, J. D. S. Huxley, E. H. Jago, K. A. Merritt, J. D. Ronald, D. G. Sinimons, W. B. S. Simpson, D. H. G. Tollemache (July 19, 1935).

The following are granted short service commissions as Acting Pilot Officers on probation with effect from and with seniority of October 19:—L. H. Baker, W. B. Baxter, A. R. H. Beauman, J. N. Bell, J. C. H. Blake, E. D. Chantler, E. G. F. Chivers, K. B. Corbould, C. T. V. Craxton, J. W. B. Davis, B. O. Dias, J. W. Fordham, J. A. L. Fowler, J. A. Ingram, R. H. James, B. R. Kerridge, F. L. Litchfield, D. H. Lowe, A. McPherson, C. Murray, J. R. S. Romanes, E. N. Ryder, J. H. Sanderson, M. A. Scott, G. E. Thompson, A. L. Vipan, E. G. Winning, R. S. C. Wood.

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation on the dates stated:—P. G. Keeble (August 6); J. L. Crisp (August 26).

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—M. H. Rhys (October 1); E. S. Butler, W. S. Jenkins (October 10); C. M. Stewart (November 1).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—R. C. Crawford, C. J. S. Dickins (September 16); J. D. T. Revel, G. A. Richmond, A. A. McMath (October 3); D. O. Finlay (October 30).

Sub-Lt. N. G. Hallett, R.N., Flying Officer, R.A.F., takes rank and precedence as if his appointment as Flying Officer bore date November 19, 1935. Reduction takes effect from August 29. (This officer relinquished his temporary R.A.F. commission on October 17, vide *Gazette* of October 27); Flt. Lt. A. R. Sarel is placed on the half-pay list, scale B, from September 21 to October 13, inclusive; Flt. Lt. J. M. Freeman is restored to full pay from half-pay (October 24); Lt. G. N. Torry, R.N., Flt. Lt., R.A.F., ceases to be attached to the R.A.F. on return to Naval duty (October 19); Flt. Lt. R. J. Montgomery-Moore is placed on the retired list (September 16); Flt. Lt. C. H. Schofield is transferred to the Reserve, Class A (October 25); P/O. J. A. Tinne is transferred to the Reserve, Class A, with effect from May 21 and resumes the rank of Flying Officer with seniority of January 5, 1934 (substituted for the notification in the *Gazette* of June 9); Flt. Lt. R. H. Page resigns his permanent commission (October 24); Lt. Comdr. L. J. S. Ede, R.N., Flying Officer, R.A.F., relinquishes his temporary commission on return to Naval duty (September 10); Acting Pilot Officer on probation R. M. Cowell relinquishes his short service commission on account of ill-health (October 25).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Air Commodore.—R. M. Hill A.F.C., to Headquarters, R.A.F., Palestine and Transjordan, Jerusalem; to command, vice Air Vice-Marshal R. E. C. Peirse, D.S.O., A.F.C., 15.9.36.

Squadron Leaders.—A. O. Lewis-Roberts, D.F.C., to No. 142 (B) Squadron, Ismailia, Egypt; to command, vice Sqn. Ldr. S. H. Ware, 5.10.36. G. R. Oliver, to Directorate of Personal Services, Air Ministry, vice Wing Cdr. A. S. Ellerton, O.B.E., 24.10.36. H. I. T. Beardsworth, to Aircraft Depot, Hinaidi, Iraq; for engineer duties vice Wing Cdr. E. J. D. Townesend, 24.10.36.

Flight Lieutenants.—A. R. Combe, W. Gill, and D. V. Johnson, to Headquarters, R.A.F., Iraq, Hinaidi, 24.10.36. A. Allen, to No. 84 (B) Squadron, Shaibah, Iraq, 24.10.36. J. Cox, to No. 70 (B.T.) Squadron, Hinaidi, Iraq, 24.10.36. P. de G. H. Seymour, to No. 5 (A.C.) Squadron, Chaklala, India, 24.10.36. A. F. McKenna, to No. 39 (B) Squadron, Risalpur, India, 24.10.36. P. J. H. Halahan, H. J. Paine, and D. McD. Fenton, to Headquarters, R.A.F., Iraq, Hinaidi, 24.10.36. E. C. Bates, to No. 55 (B) Squadron, Hinaidi, Iraq, 24.10.36. J. H. Woodin, to No. 70 (B.T.) Squadron, Hinaidi, Iraq, 24.10.36. P. Kinsey, to No. 84 (B) Squadron, Shaibah, Iraq, 24.10.36. R. S. Darbyshire, to No. 203 (F.B.) Squadron, Basrah, Iraq, 24.10.36. J. K. Brew, to No. 1 Armoured Car Company, Hinaidi, Iraq, 24.10.36. J. M. Freeman, to Aircraft Depot, Hinaidi, Iraq, 24.10.36. L. R. S. Freestone, to Headquarters, R.A.F., Aden, Steamer Point, 24.10.36. J. C. Macdonald, to No. 8 (B) Squadron, Khormaksar, Aden, 24.10.36. H. V. Satterly, to Armoured Car Section, Steamer Point, Aden, 24.10.36. M. M. Freehill, D.F.C., to School of Photography, South Farnborough, 24.10.36. H. J. L. Hawkins, to No. 210 (F.B.) Squadron, Pembroke, 22.10.36. L. G. Belchem, to No. 824 (F.S.R.) Squadron, 23.10.36.

Flying Officers.—R. G. Coventry, to No. 70 (B.T.) Squadron, Hinaidi, Iraq, 24.10.36. A. R. Leggate, to No. 203 (F.B.) Squadron, Basrah, Iraq, 24.10.36.

Pilot Officers.—J. W. Bayley, P. J. G. Davies, F. W. Flood, and V. E. R. Williams, to No. 8 (B) Squadron, Khormaksar, Aden, 24.10.36. N. A. N. Bray, R. B. Cox, L. E. Cryer and G. H. N. Gibson, to No. 20 (A.C.) Squadron, Peshawar, India, 24.10.36. F. R. McAllister and F. A. Marlow, to No. 30 (B) Squadron, Dhibban, Iraq, 24.10.36. G. R. H. Black and J. Edwardes, to No. 70 (B.T.) Squadron, Hinaidi, Iraq, 24.10.36. W. I. Hammond, to No. 203 (F.B.) Squadron, Basrah, Iraq, 24.10.36.

The undermentioned are posted to the Units shown with effect from 25.10.36:—

Pilot Officers.—J. A. G. Gordon, to No. 19 (F) Squadron, Duxford. J. W. Dallamore, to No. 83 (B) Squadron, Turnhouse.

Acting Pilot Officers.—J. C. Boulter, J. H. Coghlan, L. F. Henstock, to No. 1 (F) Squadron, Tangmere. H. Henry-May, D. B. Hobson, P. D'A. Lister, to No. 3 (F) Squadron, Kenley. P. G. Chapman, J. H. McMichael, to No. 15 (B) Squadron, Abingdon. J. E. Scoular, P. H. R. R. Terry, to No. 19 (F) Squadron, Duxford. G. R. Fielder, J. T. MacInnes, C. L. Olsson, to No. 99 (B) Squadron, Mildenhall. P. H. E. Burke, P. J. S. Shaughnessy, to No. 103 (B) Squadron, Andover. C. P. Bomford, to No. 107 (B) Squadron, Andover. E. E. M. Angell, to No. 139 (B) Squadron, Wyton. R. D. H. Maxwell, V. Mitchell, to No. 214 (B) Squadron, Scampton. P. F. R. Vaillant, to No. 215 (B) Squadron, Driffield. J. A. Bateson, W. G. Craddock, S. P. Crawley, S. R. Gibbs, E. J. S. Jones, and J. S. Kendrick, to School of Air Navigation, Manston.

The undermentioned are posted to the R.A.F. Depot, Uxbridge, on appointment to short service commissions as Acting Pilot Officers, on probation with effect from 12.10.36:—D. D. Rogers, A. J. Mould, H. R. MacD. Beall, E. D. Godfrey, J. G. McGrail, N. H. Brace, R. A. Hollaway, D. R. Hoar, W. B. Smith, A. Simpson, R. T. Chisholm, D. P. W. R. Robinson, C. G. Saunders, T. H. T. Forshaw, M. H. Roth, A. R. R. Gifford, R. D. Williams, T. W. Storey, H. E. Hopkins, H. J. Seagrin, J. T. L. Shore, D. L. R. Halliday, C. A. Wallis, E. T. Watson, M. J. Earl.

Acting Pilot Officers.—L. L. Hunt and P. A. Tipping, to No. 84 (B) Squadron, Shaibah, Iraq, 24.10.36. D. F. H. Brown, to No. 1 Armoured Car Company, Hinaidi, Iraq, 24.10.36. F. R. C. Fowle, to No. 39 (B) Squadron, Risalpur, India, 24.10.36.